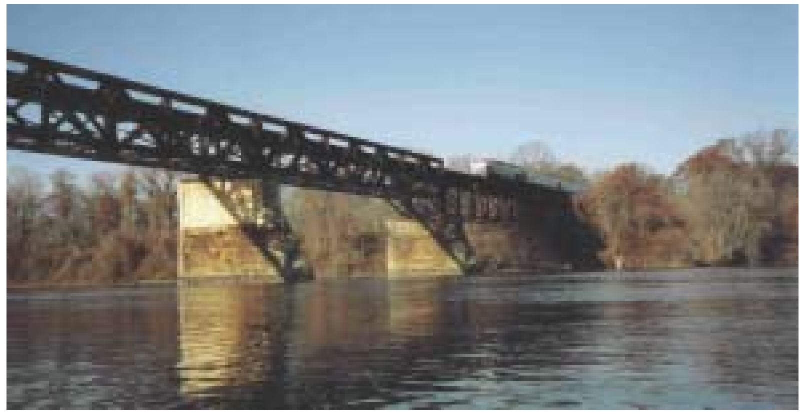
QUALITY ASSURANCE PROJECT PLAN

2003 MADEP-DWM Monitoring in the Blackstone, Chicopee, Connecticut and Nashua Watersheds

Blackstone River, RM 19.1, Millville, Ma. (June, 2002)



Connecticut River, Northfield RR Bridge, Northfield, Ma. (November, 2002)

Quabbin Reservoir, Chicopee Watershed

Nashua River, Station 29A, Pepperell, Ma. (November, 2002)

March 10, 2003

DRAFT

Massachusetts Department of Environmental Protection
Division of Watershed Management---Watershed Planning Program
627 Main Street, Second Floor, Worcester, MA, 01608

Massachusetts Department of ENVIRONMENTAL PROTECTION

QUALITY ASSURANCE PROJECT PLAN
2003 MADEP-DWM Monitoring in the Blackstone, Chicopee, Connecticut and Nashua Watersheds

CN: 127.0 **Date: March, 2003**

DWM Watershed Planning Program Supervisor: ______________________
(Dennis Dunn) (Date)

DWM Monitoring Coordinator: ______________________
(Arthur Johnson) (Date)

DWM Assessment Coordinator: ______________________
(Richard McVoy) (Date)

DWM TMDL Coordinator: ______________________
(Russell Isaac) (Date)

DWM Database Manager: ______________________
(Thomas Dallaire) (Date)

DWM Quality Control Analyst: ______________________
(Richard Chase) (Date)

DEP WES Laboratory: ______________________
(Oscar Pancorbo) (Date)

EPA, Region 1 Quality Assurance: ______________________
(Arthur Clark) (Date)

EPA, Region 1 Program: ______________________
(David Webster) (Date)

Acknowledgments:

The principle QAPP framework of this document comes from the Region I, EPA-New England Compendium of Quality Assurance Project Plan Guidance, September 1998.   Other sources of information regarding quality assurance for monitoring programs are:

- EPA Guidance for the Data Quality Objectives Process, QA/G-4, 1994
- EPA Requirements for QAPPs for Environmental Data Operations, QA/R-5, 2001
- EPA Guidance for Quality Assurance Project Plans, QA/G-5, December, 2002
- EPA Guidance on Choosing a Sampling Design for Environmental Data Collection, QA/G-5S, December, 2002, and
- EPA's Volunteer Monitor's Guide to Quality Assurance Project Plans, September 1996.

The following MADEP/DWM staff helped to formulate, review and finalize this 2003 monitoring QAPP:

• Richard Chase (QAPP preparation)
• Stella Kiras (Blackstone watershed sampling plan)
• Peter Mitchell (Connecticut watershed sampling plan)
• Greg DeCesare (Chicopee watershed sampling plan)
• Susan Connors (Nashua watershed sampling plan)
• Mark Mattson (2003 TMDL Baseline Lakes QAPP)
• Bob Nuzzo and John Fiorentino (QAPP for 2003 benthic macroinvertebrate/aquatic habitat assessment)
• Bob Maietta and Greg Decesare (fish toxics and population station selection)
• Arthur Screpetis, Arthur Johnson and Rick McVoy (QAPP review and approval)

In addition, valuable assistance in developing and finalizing sampling plans for each watershed was provided by the following EOEA and MADEP staff, as well as other agencies and groups:

• Jim Sullivan and Oscar Pancorbo (review of sample allocation and analytical issues for WES lab)
• Arthur Clark, Steve DiMattei and David Webster, EPA (QAPP review and approval)
• Blackstone watershed team, including Lynne Welsh, former EOEA team leader
• Chicopee watershed team, including Paul Lyons, former EOEA team leader
• Connecticut watershed team, including John O'Leary, former EOEA team leader
• Nashua watershed team, including Joanne Carr, former EOEA team leader
• MADEP (WERO)
• MADEP (SERO), and
• MADEP (CERO)

Document Availability:

Contrary to previous DWM QAPPs, the 2003 QAPP is mainly available in electronic format. Copies of this QAPP on CD can be obtained by contacting Richard Chase at DWM, Worcester (508-767-2859); richard.f.chase@state.ma.us.   Limited paper copies of the 2003 QAPP are available by special request only.

This document and related station location files are also available at http://www.state.ma.us/dep/brp/wm/qualmgt.htm

MADEP/DWM Contacts:

Questions regarding this 2003 QAPP and/or DWM 's monitoring programs can be directed to the following persons at MADEP:

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Disclaimer:

References to trade names, commercial products and manufacturers in this QAPP does not constitute endorsement.

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E. CERO "SMART" Program QAPP (by reference)

F. WES Quality Assurance Plan and SOPs (by reference)

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H. 2003 Schedule for Sample Delivery to WES/Severn Trent Labs (hard copy and CD version only)

I. 2003 DWM Fieldsheets, Checklists, Labels and Sample Chain-of-Custody Forms

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Executive Summary

The assessment of waterbody conditions in Massachusetts is carried out on a 5-year cycle. Selected surface waters in each watershed are sampled during Year 2 of the cycle. In 2003, monitoring by MADEP, Division of Watershed Management (DWM) will take place from approximately April through October in rivers/streams and lakes/ponds in the Blackstone, Chicopee, Connecticut and Nashua Watersheds (DEP color-coded "pink" basins). This monitoring will include water quality (e.g., dissolved oxygen, temperature, pH, coliform bacteria, phosphorus, ammonia-nitrogen, turbidity, total suspended solids), streamflow measurements, fish community monitoring, aquatic plant surveys, lake depth mapping, and may include limited benthic macroinvertebrate monitoring, aquatic habitat assessment, and fish tissue contaminant testing.

Quality assurance for watershed monitoring by the DWM, as detailed in this 2003 Quality Assurance Project Plan (QAPP), is provided to ensure implementation of an effective and efficient sampling design, and to provide data meeting specific data quality objectives. This QAPP summarizes all planned monitoring activities to be performed by DWM in 2003 to meet the following four programmatic objectives:

- Collect chemical, physical and biological data to assess the degree to which designated uses, such as primary and secondary contact recreation, fish consumption, aquatic life, aesthetics, are being met in waters of the Commonwealth
- Collect chemical, physical and biological data to support analysis and development of implementation plans to reduce pollutant loads to waters of the Commonwealth, mainly lakes (TMDL development)
- Screen fish in selected waterbodies for tissue contaminants (metals, PCBs and organochlorine pesticides) to provide for public health risk assessment
- Provide quality-assured E-coli bacteria data (in addition to fecal coliform data), due to soon-to-be-released Massachusetts freshwater criteria for E. coli.

2003 DWM Monitoring Strategy and Sampling Design Considerations:

Limited staffing and resources, combined with more water resources in need of assessment than can realistically be assessed, make the decisions on what to sample for and where to do it very difficult. In selecting the types, locations, parameters and survey frequencies that will guide the 2003 effort, each decision has been based on a collective, working knowledge of the basin (among DWM and regional DEP offices, former EOEA watershed teams, etc.), review of relevant historical data and a prioritization of monitoring needs. Many of the identified needs support DEP programmatic functions to preserve, protect, assess and restore water quality. Emphasis has been placed on assessing water quality with respect to Massachusetts' water quality standards and criteria, and on the development of implementation plans to reduce point and non-point pollutant loads.

The Statewide Water Quality Network for Massachusetts (USGS 2001) recommends a monitoring approach that will meet multiple needs of local, state, and federal agencies, and provide an effective framework for waterbody assessment and evaluation. This proposed network is divided into five tiers as follows:

- ***Tier I monitoring*** involves a basin-based assessment of existing surface water quality conditions to reflect mandates of Section 305 (b) of the Clean Water Act (CWA). Tier I is statewide in scale, comprehensive, repeated at regular intervals, and can be probabilistic or deterministic in design. The goal of Tier I monitoring is to increase the number of stream miles and lake acres that are assessed and to reduce the historical bias towards problem areas.
- ***Tier II monitoring*** involves determining contaminant loads carried by major rivers at strategic locations (e.g. mouths of major rivers, state borders).
- ***Tier III monitoring*** is targeted monitoring to identify impaired waterbodies as required by Section 303(d) of the CWA, to determine causes and sources of impairments, to identify pollution sources or "hot spots" and to allow other site-specific evaluations.
- ***Tier IV monitoring*** is to develop Total Maximum Daily Loads (TMDLs) for specific waterbodies.
- ***Tier V monitoring*** is compliance-based monitoring to meet regulatory and permit limits.

In developing the 2003 monitoring strategy and watershed-specific sampling plans, all components of this network were considered. Due to resource limitations, it is not possible to implement the network in its entirety. DWM monitoring in 2003 will collect data under Tiers I, III and IV of the statewide water quality network, with emphasis on perceived potential problem areas, such as downstream of known/potential pollution sources.

DWM's ***programmatic strategy*** under Tiers I, III and IV has the following characteristics:

- Decisions regarding where to sample, what to sample for, and when to sample are made following extensive coordination within DEP and with outside groups (former EOEA watershed teams, volunteer groups, regional offices). Decisions regarding total number of samples and analytes are made in coordination with the Wall Experiment Station (WES) and other labs, as applicable.

- Monitoring parameter selection is based on the direct use of the data by DWM for 305(b) assessments and TMDL development, as well as by other groups for a variety of purposes (e.g. citizen requests for fish tissue toxics information).

- Perceived "hot spot" locations and reference sites are targeted for periodic (typically monthly), synoptic monitoring (non-probabilistic design), with water sample collection typically done using grab sampling techniques. Inferences are often made that the observed water quality conditions for certain parameters at the time of the individual sampling survey(s) provide a reasonable picture of typical water quality conditions at those sites over an undetermined, wider bracket of time.

- Biomonitoring of benthic macroinvertebrates, aquatic plants, periphyton and fish assemblages is typically an integral component of DWM approach to 305(b) assessments and TMDLs. In 2003, the scope and magnitude of biological sampling will likely be significantly reduced (or curtailed altogether) due to staff limitations and the need to analyze and report on existing samples. To provide information necessary for making basin-wide aquatic life use designations required by Section 305(b) of the CWA, any biomonitoring stations sampled in 2003 will be compared to a regional reference station. Use of a regional reference station is particularly useful in assessing pollution impacts (e.g., physical habitat degradation), including nonpoint source pollution at upstream control sites as well as suspected chemically impacted sites downstream from known point source stressors. Some stations may not be compared to a regional reference station due to significant differences in stream morphology, flow regimes, and drainage area, or simply lack of a suitable reference site.

- The schedule of all sampling surveys for lakes and rivers (water quality, biomonitoring, fish toxics, aquatic habitat, fish population and fish toxics) is intentionally biased to occur within the primary contact season of April 1-October 15.

- Given budget, staff and logistical limitations, emphasis is given to maximizing spatial coverage wherever possible within each watershed.

- While most sampling events are intended to be "dry weather surveys" (lack of precipitation 48-72 hours prior to survey), unplanned "wet weather surveys" (antecedent precipitation sufficient to cause a significant increase in streamflow) can also occur.

- Due to soon-to-be-released Massachusetts ambient criteria for E. coli bacteria in freshwater, one of the major emphases for 2003 monitoring by DWM in the Year 2 watersheds is assessment and evaluation of bacteria levels (fecal coliform and E. coli) in mainstem rivers and tributaries.

- Like the 2003 biomonitoring effort, the level of effort given to fish toxics monitoring will likely be significantly reduced (or curtailed altogether) in 2003. Screening-level fish tissue contaminant monitoring is typically conducted due to the highly variable concentrations of bioaccumulative contaminants in fish tissue, the wide range of environmental conditions that affect bioaccumulation (bioconcentration, bioaccumulation, and biomagnification), and to allow assessment of as many of the Commonwealth's waters as possible during a given sampling season. Screening usually involves the collection of three-fish composites representing fishes of three trophic groups (i.e. predators, water column feeders, bottom feeders). Fish are analyzed for metals (As, Cd, Hg, Pb, Se), PCBs, and organochlorine pesticides. (Although screening may not accurately predict bioaccumulation patterns among a full range of year classes of any given fish species, sampling a three-fish composite of average sized individuals answers the questions with regard to the presence/absence of any given analyte and it's relative concentration. Due to the highly mobile and sometimes migratory nature of many species of freshwater fishes, fish collected from lakes are assumed to be representative of the lake as a whole).

- Lake and pond sampling by DWM in 2003 is intended to provide water quality information to support TMDL development and support 305(b) assessments. Resulting, quality-controlled data are often assumed to reasonably represent typical lake conditions during late summer stratification (resulting in increased impairment). The proposed Year 2002 Integrated List of Waters has been used to select lakes to sample and to decide what to sample for. Selected parameters are primarily due to eutrophication/ nutrient issues (total phosphorus, chlorophyll a, plants). Lakes downstream of NPDES discharges and those potentially impacted from residential development and/or impacts from historic industrial practices were given priority. Secondary selection criteria included the lack of a previous diagnostic/feasibility (D/F) study (D/F lakes will not be re-sampled), the severity of the problem, the size (generally 10 acre minimum) and public ownership of the lake and access.

- In developing the 2003 monitoring plan and QAPP, DWM made the following decisions regarding specific analytes, due to staff and budget limitations at DWM and at WES, and to a re-evaluation of usable data needs. Some of these decisions reflect changes from what DWM conducted in the past and from what would be preferred under more ideal conditions.
  - Limit the number of sampling surveys to 5 per basin, approximately monthly from May through September.
  - Except for project-specific needs, delete NO3-NO2-N and TKN from list of "Nutrients" to be sampled for in each watershed.
  - Except for project-specific needs on a limited basis, delete alkalinity, hardness and chloride ("Chemistry" bottle parameters) analyses for all watersheds.
  - Transport all bacteria and solids samples from the Connecticut and Chicopee watersheds to a contract laboratory (Severn Trent Laboratories, Inc., Westfield, Ma.) for analysis. This lab is in close proximity to both watersheds for ease and timeliness of sample delivery. (Note: As of March 5, 2003, contract negotiations with this lab have not yet begun; DWM awaits further approvals to formally award the job and finalize a contract).
  - Allow for an alternative preservation technique for TP samples (field acidification followed by 4 deg. C ice and freezing at WES for up to 6 months) to increase the amount of time in which TP samples can be analyzed.
  - As mentioned above, reduce the scope and magnitude of benthic macroinvertebrate, fish population, aquatic habitat assessment and fish tissue contaminant monitoring.
  - Limit pre-dawn D.O. monitoring to the summer months when the likelihood of observing diurnal oxygen minima in the pre-dawn hours is greatest (high temperature/low streamflow months of June- September).

Planned DWM 2003 Monitoring:

Table ES1 summarizes the estimated 2003 monitoring effort, based on existing DWM staffing and a limited number of seasonal employees to assist in sample collection and transport, lab duties and other tasks as assigned. It is likely that the number of parameters, stations and/or surveys may need to be scaled back subject to staff and resource availability from April through October, 2003.

2003 Quality Assurance Planning:

This QAPP covers the 20 standard QAPP elements contained in the EPA Region I Compendium QAPP Guidance. Elements 1-4 and 9-20 are applicable to monitoring activities in all of the Year 2 watersheds. Elements 5-8 containing basin-specific information (on station locations, monitoring parameters, sampling schedules, historical data, and sampling design) for each Year 2 watershed are separated and tabbed for convenience. Where applicable, reference is made to separate QAPPs and SOPs, adopted by reference, for more specific information. The primary 'programmatic' QAPPs applicable to 2003 monitoring include:

- 2003 Baseline Lakes TMDL QAPP (CN 128.0)
- 2003 Benthic Macroinvertebrate Monitoring QAPP (CN 147.0)
- Fish Toxics Program QAPP (CN 96.0)

This QAPP is not a rigid document. Changes may be required based on new information, additional site reconnaissance, draft QAPP review and/or policy changes. In cases where changes are proposed and made in the monitoring program (before or after monitoring has begun), the QAPP will be revised and approved as appropriate. The DWM Year 2 QAPP thus remains a useful planning and performance guide, as well as an accurate documentation of what monitoring is taking place.

NOTE: ***Recent preliminary decisions have been made to significantly restrict the amount of biological monitoring taking place in 2003. For informational purposes (and to hold their place should sampling be performed), previously proposed biological sampling sites and related information have been retained in this QAPP.***

Table ES1: Watershed-Specific Summary of Planned 2003 DWM Monitoring (from approx. April-October).

Survey Type	Watershed	Waterbodies Sampled	# Segments Sampled [1]	# Stations Sampled	2002 ILW Sampled [2]		Category 5 Pollutant(s) Addressed [3]	# Surveys & Frequency
					Cat. 3	Cat. 5		
Stream/River Water Quality (multi-probe, nutrients, solids, bacteria, chemistry)	Blackstone	12	17	21	1	**14**	ABCIMNPQ	5, Monthly (Spring-Fall)
	Chicopee	14	23+	36	6	**12**	ABCHIJ	5, Monthly (Spring-Fall)
	Connecticut	22	25+	32	8	**6**	ABNQ	5, Monthly (Spring-Fall)
	Nashua	13	20	25	7	**11**	ABCHIMN	5, Monthly (Spring-Fall)
Lake/Pond Water Quality (multi-probe, phosphorus, aquatic plants, Chlorophyll a, Secchi depth, color, lake morphometry)	Blackstone	6	---	6	0	**6**	BGMS	3, Monthly (Summer)
	Chicopee	2	---	2	0	**2**	S	3, Monthly (Summer); also monthly (TP only)
	Connecticut	6	---	6	0	**6**	BGMNS	3, Monthly (Summer)
	Nashua	4	---	4	0	**4**	GMNS	3, Monthly (Summer)
Stream/River Benthic Macroinvertebrates and Aquatic Habitat Assessments	*Blackstone*	*7*	*11*	*15*	*0*	***8***	*BHIK*	*1*
	Chicopee	*7*	*10*	*14*	*2*	***2***	*B*	*1*
	Connecticut	*15*	*15*	*16*	*7*	***6***	*BKQ*	*1*
	Nashua	*9*	*15+*	*18*	*1*	***10***	*HIK*	*1*
Fish Assembleges in Rivers/Streams	*Blackstone*	*10-15+*	*3-5+*	*10-15+*	*2*	*2*	*BK*	*1*
	Chicopee	*7*	*10*	*14*	*2*	*2*	*B*	*1*
	Connecticut	*10*	*10*	*11*	*6*	*2*	*B*	*1*
	Nashua	*9*	*16*	*18*	*1*	*0*	---	*1*
Fish Tissue Contaminants	*Blackstone*	*3*	---	---	*0*	*0*	---	*1*
	Chicopee	*2*	---	---	*0*	*0*	---	*1*
	Connecticut	*3*	---	---	*0*	*0*	---	*1*
	Nashua	*2*	---	---	*0*	*0*	---	*1*
Streamflow Measurement	Blackstone	2	3	3	0	0	---	3 X (April, June, August)
	Chicopee	4	5	7	2	0	---	3 X (April, June, August)
	Connecticut	0	0	0	0	0	---	---
	Nashua	8	8	10	6	0	---	4 X (Spring-Fall)

[1] Only identified segments counted; "+" indicates that one or more stations to be sampled are in un-identified or new segments

[2] Number of waterbody segments for which specific monitoring is proposed to address Category 3 (insufficient information to make assessments for any uses) and Category 5 (impaired or threatened for one or more uses and requiring a TMDL) waters from the *Massachusetts proposed 2002 Integrated List of Waters.*

[3] Key to Category 5 pollutants listed for segments to be sampled AND that will be addressed via specific survey-type monitoring:

- A = pathogens
- B = organic enrichment/low DO
- C = taste, odor, color
- D = chlorine
- E = metals (in tissue)
- F = organics (in tissue)
- G = noxious aquatic plants
- H = unknown toxicity
- I = cause unknown
- J = thermal modifications
- K = habitat alteration
- L = oil & grease
- M = turbidity
- N = nutrients (phosphorus, ammonia-N)
- O = flow alteration
- P = pH
- Q = suspended solids
- R = siltation
- S = exotic species

Note: *Italics* indicate monitoring effort will likely be significantly reduced from these levels, and is subject to further decision-making.

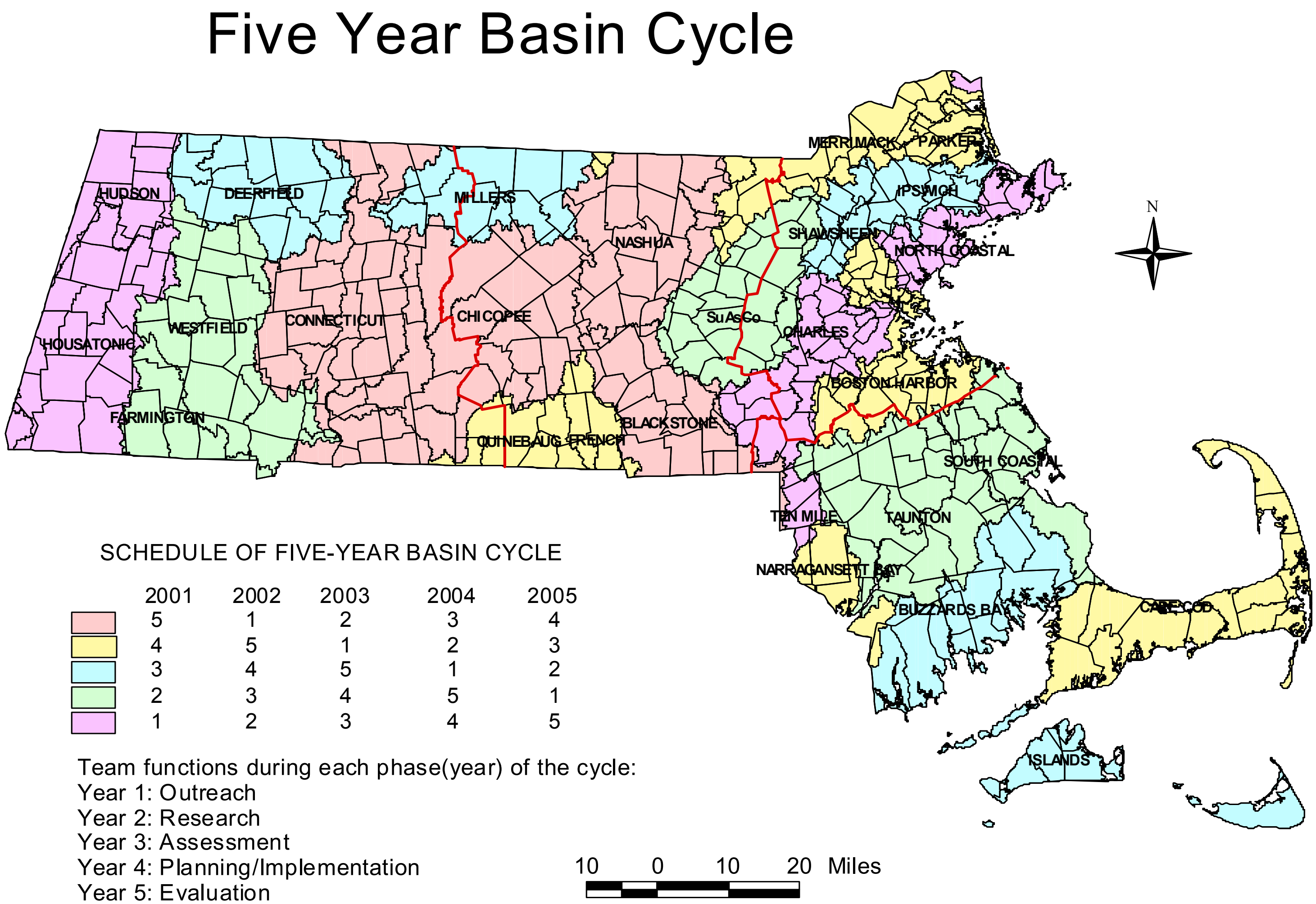

Figure 1: Massachusetts Five-Year Watershed Strategy

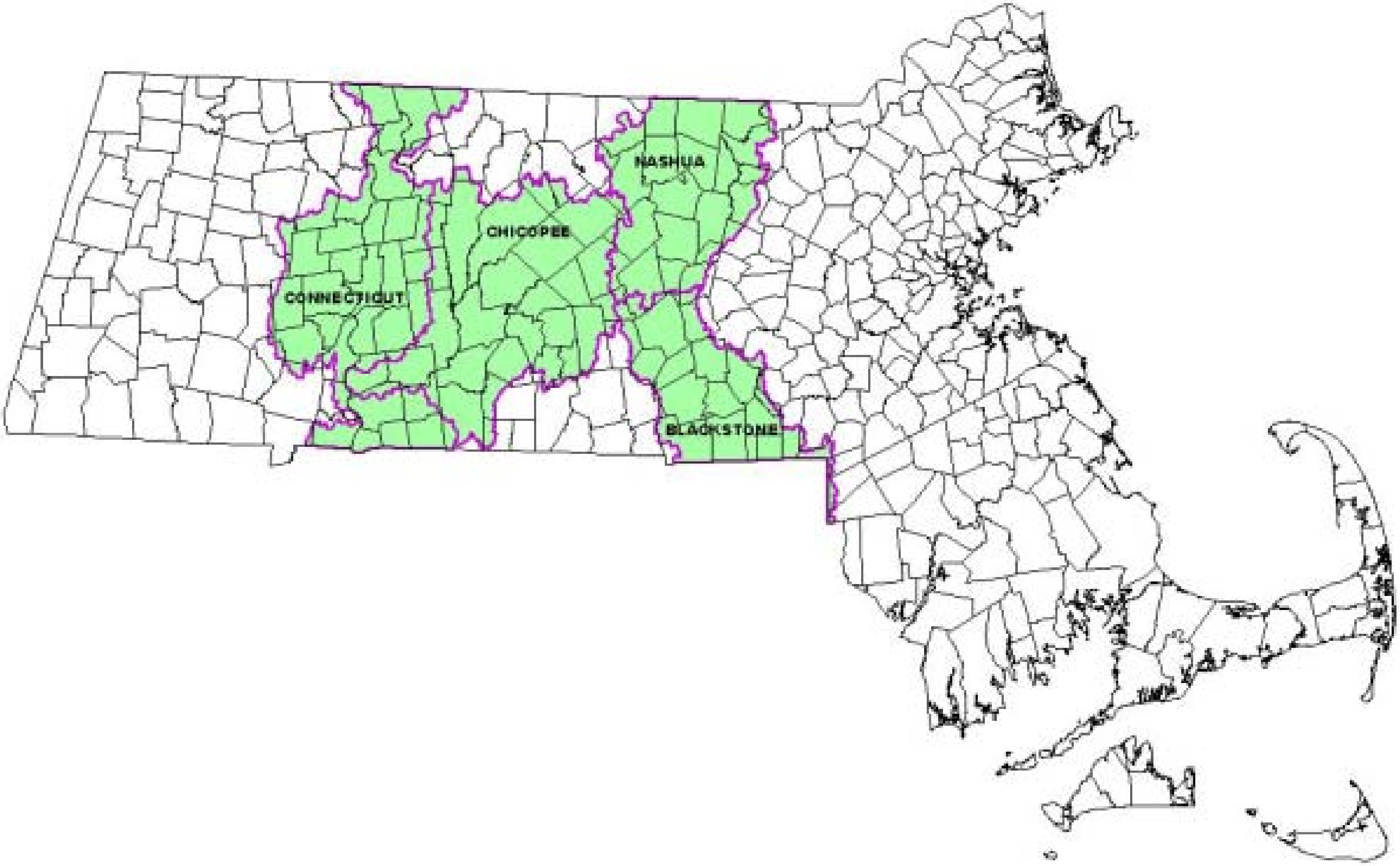

Figure 2: 2003 DWM Monitoring Watersheds

3.0 QAPP DISTRIBUTION AND APPROVAL

3.1 QAPP Distribution

The following persons have received a draft review copy and a final copy of this Quality Assurance Project Plan (QAPP):

• Stella Kiras
• Katie O'Brien
• Susan Connors
• Pete Mitchell
• Oscar Pancorbo (WES lab)
• Arthur Screpetis
• Arthur Johnson
• Richard McVoy
• Jeffrey Smith
• Arthur Clark, Steve DiMattei and David Webster (EPA Region 1)

A hard copy (CD) will be placed in the DWM library for general reference and a soft disk copy will be placed on the network W drive (W:\dwm\sop\cn127.0 – QAPP for 2003 DWM Monitoring in the Blackstone, Chicopee, Connecticut and Nashua Watersheds) and Y drive.

3.2 QAPP Approval

This QAPP is the culmination of several months of background review, coordination and basin reconnaissance by DWM monitoring coordinators and other DWM staff. In developing the sampling plans for each basin as presented in this QAPP, the DWM review and approval process has been a continuous task.

The draft QAPP was reviewed by those persons identified in 3.1, and review comments were incorporated where necessary. The final draft QAPP has been submitted to the signatories identified on the cover/signature page for review and formal approval. Once approved, the QAPP planning process is essentially completed, except for any proposed and approved changes prior to and/or during monitoring. If changes are proposed, an abbreviated approval process for the changes shall be completed. If and when any changes are made to this QAPP and contingent on staff availability, updated hard copies shall be provided to those requesting them, and an updated hard copy will be placed in the DWM library. Contingent on staff availability, necessary updates shall be made to the network drive disc copy and the world wide web copy as well (the name of the file will be changed to reflect the document's revised status (e.g. CN 127.1 for a revised CN 127.0)). After monitoring has been completed and the QAPP updated, the QAPP shall reflect what, where, when, why and how monitoring actually occurred.

4.0 PROJECT ORGANIZATION

4.1 DWM Organization Chart for 2003 Monitoring:

See **Figure 3** for the organizational structure within DEP/DWM for 2003 watershed monitoring.

The current level of staffing within DWM to perform the work outlined in this QAPP is minimal, and should be augmented with a number of seasonal employees from May through September to ensure performance. Due to budget constraints, there is a possibility that very few or no seasonal (summer-fall) employees will be hired in 2003. Because these workers provide valuable assistance in DWM sampling surveys, DWM lab analyses, sample transport and WES lab analyses, this lack of assistance may significantly curtail the magnitude and coverage of the 2003 monitoring effort. Due to these special circumstances, special efforts have been made to enlist outside-DWM volunteer assistance from other potential sources, such as DEP regional offices, 'pink' basin volunteer groups, interns earning college credits and other agencies (eg. EPA).

4.2 Responsible Persons, Qualifications, and Training:

Refer to **Table 1** for specific descriptions of DWM staff roles and responsibilities for 2003 monitoring.

For each field monitoring survey event, the person serving as the survey crew leader (at a minimum) will have the following qualifications:

- Familiarity with this QAPP and all applicable SOPs for that survey
- Completion of a multiprobe sampling/grab sampling/QC training segment, and
- Prior field experience with field equipment and with similar monitoring surveys
- Recent training in CPR/first aid by the American Red Cross (at least one certified person per survey)
- Be physically able to access the stations, carry equipment and samples, and perform the sampling.

Survey crew leaders will be accompanied by 1-2 additional crew members for each survey. All field survey crew personnel and WES/DWM lab personnel will be trained in the proper application of standard operating procedures (SOPs). Due to the manpower constraints explained above, the field training may range from formal DWM training sessions to field instructions provided by a trained and experienced DWM survey crew leader. DWM lab training (e.g. chl a, color, and turbidity analyses) will be provided to selected DWM staff (who will run the analysis). All DWM training activity will be documented.

Oscar Pancorbo, WES Director, and Jim Sullivan, Inorganic Laboratory Supervisor, will share the role of coordinating with DWM regarding sample delivery, analyses and reporting. In addition, other WES staff shall be responsible via the Laboratory Information Management System (LIMS) for reporting results.

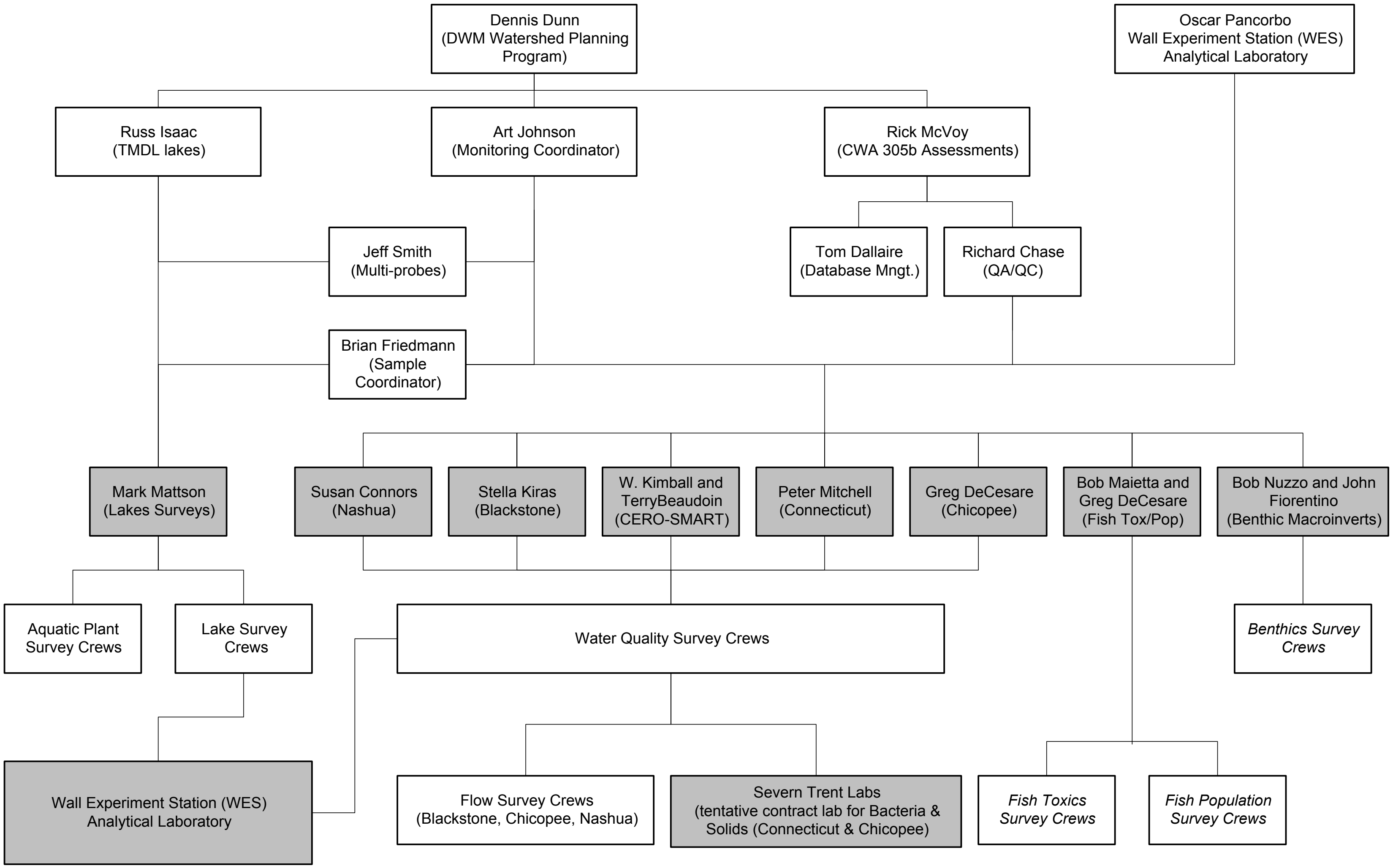

Figure 3: 2003 DWM Organizational Chart

TABLE 1. Personnel Responsibilities and Training

Project Personnel, Title and Affiliation	Responsibility	Training	Training Date/ Instructor(s)	Location of Training Records
Rick Dunn, Program Supervisor, Watershed Planning; DWM	Responsible for overall management of administrative and technical work by Watershed Planning.	NA	NA	NA
Arthur Johnson, Environmental Monitoring Coordinator, DWM	Responsible for the planning and coordination of all environmental monitoring by DWM. This includes technical oversight, staff assignments and scheduling.	NA	NA	NA
Rick McVoy, Assessment Coordinator, DWM	Responsible for completion of CWA Section 305(b) data collection and assessment, including technical oversight, especially with regard to lake surveys (limnology, aquatic plant ID).	NA	NA	NA
Russ Isaac, TMDL Coordinator, DWM	Responsible for the development and implemention of Total Maximum Daily Loads (TMDLs) for State waters. Also provides technical oversight in the development and evaluation of ambient water quality standards.	NA	NA	NA
Richard Chase, Quality Control Analyst, DWM	Responsible for overall quality assurance and quality control for environmental monitoring and data handling at DWM, including SOP development, training, data review and validation, QC reporting, lab coordination and QAPP development.	1) CPR and first aid 2) Multiprobe/QC	1) American Red Cross (ARC) in March, 2003 2) DWM (Smith andChase) in March, 2003	DWM, Worcester
Oscar Pancorbo and Jim Sullivan, Wall Experiment Station (WES) Lab, Lawrence, Ma.	Responsible for overall lab management and technical oversight regarding the performance of water quality analyses according to established EPA Methods and WES laboratory Standard Operating Procedures (SOPs).	NA	NA	NA
Tom Dallaire, Database Manager, DWM	Responsible for database management at DWM, including downloading and processing of raw Multi-probe® data, data entry, database development and database exports.	NA	NA	NA
Jeff Smith, Multiprobe and Equipment Coordinator	Responsible for calibration and maintenance of multi-probe instruments, following the procedures stated in the Multi-probe® Series 3 Multi-probe, CN 4.1 standard operating procedure, and other as applicable. Also, trains DWM staff in the proper use of the multi-probes and other equipment.	1) Multiprobe/QC	1) DWM (Smith and Chase) in March, 2003	DWM, Worcester
Brian Friedmann, Sample Coordinator	Responsible for the preparation of sample containers and field blanks, and for obtaining the necessary preservatives for analytical samples from WES.	1) Multiprobe/QC	1) DWM (Smith andChase) in March, 2003	DWM, Worcester

TABLE 1. Personnel Responsibilities and Training (cont.)

Project Personnel, Title and Affiliation	Responsibility	Training	Training Date/ Instructor(s)	Location of Training Records
Watershed Survey Coordinators: - Susan Connors (Nashua) - Greg DeCesare (Chicopee) - Stella Kiras (Blackstone) - Pete Mitchell (Connecticut); cert. EMT	Responsible for developing the sampling plan/design for a specific watershed, including coordination with other historic/current monitoring groups, establishing survey goals and minimum data requirements, and defining logistics for efficient samples collection and generation of useable data.	1) CPR and first aid	1) American Red Cross (ARC) in March, 2003	DWM, Worcester
		2) Multiprobe/QC	2) DWM (Smith andChase) in March, 2003	
		3) Turbidity analysis	3) DWM (Chase) in May/June (as needed for field turbidimeter)	
		4) Chlorophyll a and color analyses	4) DWM (Beskenis, Mattson) in April, 2003	
Mark Mattson, Baseline Lakes TMDL Survey Coordinator	Responsible for developing the sampling plan/design and QAPP for the baseline lakes TMDL sampling, as well as for any special training (eg. aquatic plant surveys) for lake monitoring crews. Also, training for DWM lab color analysis.	1) CPR and first aid	1) American Red Cross (ARC) in March, 2003	DWM, Worcester
		2) Multiprobe/QC	2) DWM (Smith andChase) in March, 2003	
Water quality survey crews (DWM staff, seasonal employees, regional office staff, EOEA personnel and volunteer assistance as needed)	Under the direction of the survey coordinators and survey crew leaders, the water quality field crews will follow the sample collection techniques and Multi-probe use procedures contained in DWM SOPs. Also, selected staff shall perform in-house apparent color, chlorophyll a and turbidity analysis	1) CPR/first aid	1) American Red Cross (ARC) in March, 2003	DWM – Worcester
		2) Multiprobe/QC	2) DWM (Smith andChase) in March, 2003	
		3) Turbidity analysis	3) DWM (Chase) in May/June (as needed for field turbidimeter)	
		4) Aquatic Plant ID	4) DWM (McVoy and Decesare) on-going/as-needed	
		5) Chlorophyll a and color analyses	5) DWM (Beskenis, Mattson) in April, 2003	
Flow survey crews (DWM) - Elaine Hartman - Kathleen Keohane - Mark Mattson - Bob Maietta - Richard Chase - Jeff Smith - Brian Friedmann - Others TBD	Responsible for the accurate measurement of ambient stream/river flows per DWM SOPs (CN 68.0, 68.1).	1) Flow measurement training and review	1) DWM group training sessions (April, 2003).	DWM - Worcester

TABLE 1. Personnel Responsibilities and Training (cont.)

Project Personnel, Titles and Affiliation	Responsibility	Training	Training Date/ Instructor(s)	Location of Training Records
CERO/SMART survey crews: - Terry Beaudoin - Warren Kimball - CERO staff as needed - Others TBD	Responsible for the SMART surface water monitoring program in the Mass. Central Region, including the Year 2, 2003 "pink" basins (Blackstone, Nashua and Chicopee). In 2003, SMART staff will assist DWM at several locations by taking additional samples (mainly bacteria)	1) Multiprobe/QC	1) DWM (Smith and Chase) in March, 2003	DWM, Worcester
Connecticut/Chicopee Laboratory: Severn Trent Labs, Westfield, Ma. (tentative)	Responsible for accurate and precise laboratory analysis of water samples as directed by DWM	Lab-specific consistent with lab QA plan	Lab-specific consistent with lab QA plan	Lab-specific consistent with lab QA plan
Fish population survey crews (DWM) - Bob Maietta (lead) - Greg DeCesare (lead) - Pete Mitchell (lead); cert. EMT - DWM staff as needed	Responsible for conducting accurate, precise fish population sampling per DWM SOPs using electrofishing techniques.	1) CPR and first aid 2) Multiprobe/QC	1) American Red Cross (ARC) in March, 2003 2) DWM (Smith andChase) in March, 2003	DWM, Worcester
Fish tissue survey crews (DWM) - Bob Maietta (lead) - Greg DeCesare (lead) - DWM staff	Responsible for fish survey involving fish collection and preparation for fish tissue toxics analysis by WES. Also responsible for any ancillary water quality data collected during fish surveys.	1) CPR and first aid 2) Multiprobe/QC	1) American Red Cross (ARC) in March, 2003 2) DWM (Smith andChase) in March, 2003	DWM, Worcester
Benthic macroinvertebrate survey crews (DWM) - Bob Nuzzo (lead) - John Fiorentino (lead) - DWM staff	Responsible for benthic macroinvertebrate and aquatic habitat survey data collection. Also responsible for any ancillary water quality data collected during benthic surveys.	1) CPR and first aid 2) Multiprobe/QC	1) American Red Cross (ARC) in March, 2003 2) DWM (Smith andChase) in March, 2003	DWM, Worcester

Blackstone River, Station 9C, Worcester, Ma. (October, 2002)

5.0 PROJECT DEFINITION AND BACKGROUND INFORMATION

5.1 Goals & Objectives and Intended Use of the Blackstone River Watershed Data

The watershed assessment process in Massachusetts is carried out on a 5-year cycle. In Year One, the Division of Watershed Management (DWM) coordinates with watershed groups, gathers background information and begins to formulate sampling needs for streams, rivers, ponds and lakes in pre-determined watersheds. During Year Two of the cycle, sampling sites and parameters are finalized and sampling is conducted. In Year Three, the finalized data are used for assessment reporting to comply with Section 305(b) of the Clean Water Act (CWA). Implementation of specific projects or programs to address water quality problems, and post-project evaluation are conducted in Year Four and Year Five, respectively.

The goal of the Blackstone River Watershed Year Two Survey is to obtain information at a total of 27 water quality sampling stations that meets the following DWM programmatic objectives and watershed-specific sub-objectives.

Objective 1: Evaluate specific water bodies for support of designated uses, determine if State surface water quality standards are being met, evaluate the level of waterbody impairment, and provide data on previously un-assessed waterbodies.

► Provide water quality data (bacteria and chemistry) for previously un-assessed waterbodies as well as previously assessed waterbodies
► Evaluate aquatic life use support, as indicated by macroinvertebrate, periphyton, fish assemblages, and habitat at approximately 15 stations (***subject to revision***)

Objective 2: Provide quality-assured data for use by DWM in developing Total Maximum Daily Loads (TMDLs) for State waterbodies.

► Collect data from six lakes for use in DWM's development of the Total Phosphorus TMDLs

Objective 3: Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides).

► Assess screening-level fish toxicity at three lakes (Eddy, Singletary, and Manchaug ponds) in the Blackstone River Watershed for potential public health concerns (***subject to revision***)

Objective 4: <u>Provide quality-assured E. coli data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts's freshwater criteria for *E. coli*.</u>

5.2 Blackstone River Watershed Map

The Blackstone River Watershed 2003 monitoring locations are shown in **Figure B1**.

5.3 Recent Historical Data

See also **Table B2** for summary of recent historical data.

The United States Congress designated the Blackstone River Valley a National Heritage Corridor in 1986. It is a partnership park that stretches from the headwaters of the Blackstone River in Worcester, Massachusetts to Narragansett Bay in Providence, Rhode Island. The heritage corridor effort is operated in conjunction with the Secretary of the Interior through the National Park Service, a National Corridor Commission representing the interests of the local communities, and several key state agencies from both Massachusetts and Rhode Island (ACOE 1997a).

<u>Watershed Studies: 1990 - 2000</u>

The most significant and comprehensive study of the Blackstone River began in 1990 as an interagency interstate study of the river system during dry and wet weather conditions (Wright *et al*. 1998). The Blackstone River Initiative (BRI) project was a cooperative effort among the Environmental Protection Agency (EPA), the University of Rhode Island, and the Massachusetts Department of Environmental Protection (MA DEP). The BRI was designed to assess dry and wet weather loadings, assess toxicity based NPDES controls, assess development of site specific criteria for metals, and to make informed decisions on future pollution controls in the Blackstone River. This was accomplished with field monitoring to assess conditions during storm events and during dry weather (base flow) conditions, and modeling of dissolved oxygen, suspended solids, and metals. The information collected under the BRI was used to develop a wasteload allocation computer model for the entire river in both Massachusetts and Rhode Island. This computer model, was used by the states to develop NPDES permit limits for municipal facilities on the mainstem. Follow-up monitoring was conducted during 1998 by DWM, and focused on the areas that the BRI identified as either "hot spots" or needing further monitoring, specifically in the numerous headwater tributaries and on the West River (MA DEP 2001).

In 1998, monitoring of the Blackstone River Watershed was performed by DWM. Data is available in the *Blackstone River Basin 1998 Water Quality Assessment Report* (Report control number 51-AC-1) (MA DEP 2001). The study included water quality monitoring; bacteria, fish toxics, fish population, periphyton and benthic macroinvertebrate sampling; and lake synoptic surveys. Additionally, DWM fish toxics monitoring was conducted at two locations (University Park Pond, Worcester, and Coes Reservoir, Worcester) during the 1998 sampling season. Data from this survey can be found in Appendix B of the *Blackstone River Basin 1998 Water Quality Assessment Report*. The complete DWM benthic macroinvertebrate study and results can be found in Appendix C of the assessment report and in a separate memorandum, *Blackstone River Watershed 1998 Biological Assessment* (Report control number TM-51-8).

A 12-month reconnaissance investigation to assess potential environmental restoration of the Blackstone River was completed in August 1997 by the Army Corps of Engineers (ACOE). The study identified the federal interest in environmental restoration plans for the watershed, and determined the type and cost of prototype projects that could potentially be constructed throughout the watershed (ACOE 2002). Key components of this study included an assessment of the threat from contaminated sediments, an inventory of environmental restoration opportunities in the watershed, a determination of the role of impoundments on water quality and sediment resuspension, and an inventory of dams and their condition (ACOE 2002).

As recommended by the ACOE 1997 reconnaissance study, Battelle was contracted by the ACOE to conduct an Ecological Risk Assessment (ERA) of two impoundments along the Blackstone River (Fisherville and Singing ponds) (Battelle 2000a and 2000b). Sediment samples were collected from three river impoundments located in the Blackstone River Watershed (Fisherville, Singing, and Wildwood ponds) in October 1999 (Battelle 2000a). These sediment samples were analyzed for physical, chemical, and biological parameters. Fish samples were also collected at these waterbodies, and were analyzed for metals and PCBs (Battelle 2000a). A Draft Final Data Report Feasibility Study was completed in April 2000. The results presented in the Feasibility Study indicated that the bioavailability of sediment-associated contaminants within the river impoundments was low.

Ongoing Watershed Monitoring:

There are currently four United States Geological Survey (USGS) stream gages located within the Blackstone River Watershed in Massachusetts. Discharge and duration data are obtained from three of the gages: Quinsigamond River at North Grafton (01110000), Blackstone River at Millbury (as of July 2002) (01109730), and Blackstone River at Northbridge (0110500). The fourth gage is the Blackstone River at Millville (01111230); the USGS collects chemical, microbiological, temperature, and sediment at this location, in addition to discharge data. The current data can be found in the *Water Resources Data for Massachusetts and Rhode Island, Water Year 2001* reports (Socolow *et al.* 2002).

The ACOE New England Division (NAE) owns and operates the West Hill Dam project on the West River (Upton, Northbridge, and Uxbridge) (MA DEP 2001). The goals of the ACOE reservoir water quality control management program are to protect public health and safety, meet and maintain State water quality standards, and identify impacts on water quality. Activities conducted under the Reservoir Water Quality Operation and Maintenance Program include potable water and bathing beach water quality monitoring, baseline monitoring of Class I projects (i.e. projects that exhibit consistently high water quality) with conservation pools, and the continuation of a study on the relationship between rainfall and elevated bacteria counts at project beaches (MA DEP 2001). Beaches are monitored biweekly from May through Labor Day and the assessment of the data collected in these programs is presented in annual reports. Based on previous NAE water quality reports, the West Hill Dam project is considered to be a Class I project (MA DEP 2001).

The City of Worcester Department of Public Works (DPW), was the first city in New England to receive a National Pollutant Discharge Elimination System (NPDES) permit for its Municipal Separate Storm Sewer System or MS4. The Permit was issued by the United States Environmental Protection Agency, and covers any city owned drainage outfalls that discharge to lakes, streams, rivers, and ponds within the City of Worcester. As part of the NPDES stormwater permit, the City of Worcester is required to implement both wet and dry weather monitoring to estimate annual, mean and seasonal discharge loadings from all major outfalls and to identify illicit connections and improper discharges. Worcester rotates their investigatory sampling and inspection efforts through their five subwatersheds: Lake Quinsigamond in 1999, Indian Lake/Mill Brook subwatershed in 2000, Kettle/Tatnuck Brook subwatershed in 2001, Beaver Brook subwatershed in 2002, and the Blackstone/Middle River subwatershed in 2003 (MA DEP 2001). Under the Stormwater Management Program, the City performs many Best Management Practices (BMPs). Some of these BMPs include education, public outreach, street sweeping, catch basin cleaning, source control and structural modifications. These BMPs when combined with the sampling and monitoring program within Stormwater Management Program continue to locate and eliminate pollution sources throughout the life of the permit term. An annual report summarizing the stormwater discharge program must be submitted to both DEP and EPA (MA DEP 2001).

There are eight municipal wastewater treatment plants (WWTPs) in the Blackstone River Watershed. All eight facilities submit toxicity testing reports to EPA and DEP as required by their NPDES permits. Data from these toxicity reports are maintained by DWM in a database entitled "Toxicity Testing Data - TOXTD". Information from the reports includes: survival of test organisms exposed to ambient river water (used as dilution water), physicochemical analysis (e.g., hardness, alkalinity, pH, total suspended solids) of the dilution water, and the whole effluent toxicity test results (MA DEP 2001).

The Adopt-A-Stream Program is part of the Riverways Programs in the Department of Fisheries, Wildlife and Environmental Law Enforcement (DFWELE). The Program works to support and encourage local Stream Teams and communities in efforts to protect and restore the ecological integrity of the Commonwealth's rivers, streams and watersheds. In 2001, the Blackstone River Watershed Association hired a Stream Team Coordinator to lead Stream Team development and water quality monitoring in the watershed (DFWELE 2001). The following shoreline surveys, in the Blackstone River Watershed, have been completed through the Adopt-A-Stream Program: Miscoe Brook Stream Team: Miscoe Brook, Tatnuck Brook Stream Team: Tatnuck Brook, Ararat Brook Stream Team: Ararat Brook, Mumford River Stream Team: Mumford River.

The Lake Watershed Stewardship Program is a pilot program through the Riverways Programs that involves 99 volunteers to determine causes of impaired lakes to plan and implement solutions (Funded by federal funds through the s. 319 Program through DEP). This program has provided training for watershed surveys, facilitated Action Planning meetings and supported implementation for all surveys. In 2002, volunteer groups in Millbury, Worcester, and Auburn conducted visual watershed surveys of the Mill Brook Watershed (upstream from Salisbury Pond), the Auburn and Worcester areas of the Leesville Pond /Kettle Brook Watershed, and the Dorothy Pond/ Broad Meadow Brook Watershed (Carney 2003).

From 1996 through 2000, shoreline surveys were conducted by volunteers in many headwater streams of the Blackstone River in Shrewsbury and Worcester (Coffin 2001). The water quality monitors are part of a Mass Audubon and Heritage Corridor project called the Blackstone Headwaters Monitoring Team (BHMT). The Blackstone Headwaters Coalition (BHC) was launched in September 1999; it has only been recently that BHC has taken on a role to assist in coordinating the BHMT because its membership and mission is expanding. The Team presently consists of 25 volunteers who visit 26 sites in the Blackstone River headwater tributaries in and around the City of Worcester. Teams on shore and in boats noted conditions in the water bodies and along the banks, and recorded land uses, erosion, surface pipes, siltation/sedimentation, trash, odors, sheens, foams, aquatic vegetation, color, solid waste, and recreational resources (MA DEP 2001).

The MA DEP Central Regional Office Bureau of Resource Protection conducts a water quality monitoring program in six of the watersheds that occur within Central Massachusetts, including the Blackstone River Watershed. The goals of this program are to determine existing water quality conditions, quantify loadings, calibrate models, and evaluate the water body for "fishable, swimmable" uses as defined in Section 305(b) of the Clean Water Act. Through this Strategic Monitoring and Assessment of River basin Teams (SMART) program, water quality has been sampled bi-monthly at five locations in the watershed from 2000 to the present. The sampling stations are located to reflect conditions in the headwaters, at the state border, major discharges, and key tributary locations. SMART monitoring also includes field observations and photographic documentation of watershed conditions.

The Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement conducted fish population studies at 64 stations in the Blackstone River Watershed in 2000. DFWELE sampling was conducted under SOP's consistent with DWM protocols. DWM has coordinated with DFWELE to avoid duplication of efforts in 2003, address comparability of data, and increase spatial coverage. DFWELE plans to write a Watershed-Based Fisheries Management Plan that would include the data and an assessment of the resources in the basin (O'Brien 2003).

5.4 Data Gaps

The assessment of the waters in the Blackstone River Watershed remains incomplete. The spatial coverage and temporal coverage omits waterbodies. Although, it is the goal of DWM to assess all the waters of the Commonwealth, it is logistically and economically impossible to attempt to assess all waterbodies in the Blackstone River Watershed in a single year.

Fifteen river segments were on the 1999 303(d)-list of impaired waters. These have since been revised to be on the Massachusetts Year 2002 Integrated List Category 5 Waters - "Waters requiring a TMDL". Monitoring of these segments during the Year Two period can provide data in the development of TMDLs. Emphasis will be placed on coordinating efforts with federal, state, local government, and volunteer organizations. The following is a list of the Massachusetts Category 5 Waters - "Waters requiring a TMDL" in the Blackstone River Watershed:

Table B1. Massachusetts Category 5 Waters - "Waters requiring a TMDL"

NAME	SEGMENT	POLLUTANT NEEDING TMDL
Beaver Brook	MA51-07	-Cause Unknown, (Other habitat alterations), Pathogens, (Objectionable deposits)
Blackstone River	MA51-03	-Unknown toxicity, Priority organics, Metals, Unionized Ammonia, Chlorine, Nutrients, Organic enrichment/Low DO, (Flow alteration) (Other habitat alterations), Pathogens, Suspended solids, Turbidity, (Objectionable deposits)
Blackstone River	MA51-04	-Unknown toxicity, Priority organics, Metals, Nutrients, Organic enrichment/Low DO, (Flow alteration), Pathogens, Taste, odor and color, Suspended solids, Turbidity
Blackstone River	MA51-05	-Unknown toxicity, Priority organics, Metals, Nutrients, pH, (Flow alteration), Pathogens, Taste, odor and color, Suspended solids, Turbidity
Blackstone River	MA51-06	-Priority organics, Nutrients, pH, (Flow alteration), Pathogens, Taste, odor and color, Suspended solids, Turbidity
Dark Brook	MA51-16	-Cause Unknown
Kettle Brook	MA51-01	-Cause Unknown, Nutrients, Organic enrichment/Low DO, (Flow alteration), Pathogens

Table B1(cont.) Massachusetts Category 5 Waters - "Waters requiring a TMDL"

NAME	SEGMENT	POLLUTANT NEEDING TMDL
Middle River	MA51-02	-Cause Unknown, Unknown toxicity, Metals, Nutrients, pH, Organic enrichment/Low DO, (Other habitat alterations), Pathogens, Turbidity, (Objectionable deposits)
Mill River	MA51-10	-Priority organics, Metals
Mumford River	MA51-14	-Metals, pH, Organic enrichment/Low DO, Pathogens
Peters River	MA51-18	-Metals, Pathogens
Tatnuck Brook	MA51-15	-Cause Unknown, (Other habitat alterations), Turbidity, (Objectionable deposits)
Unnamed Tributary "Mill Brook"	MA51-08	-Priority organics, Metals, Unionized Ammonia, Nutrients, Organic enrichment/Low DO, (Other habitat alterations), Pathogens, Oil and grease, Taste, odor and color, Suspended solids, Turbidity, (Objectionable deposits)
West River	MA51-11	-pH, Organic enrichment/Low DO, Pathogens
West River	MA51-12	-Metals, Nutrients, pH, Organic enrichment/Low DO, Salinity/TDS/chlorides

Table B2. Summary of Recent Historical Data

Data Source (Originating Organization, Report Title and Date)	Data Collection Type	How Data Will Be Used	Limitations on Data Use
Stream Teams – several stream teams conduct shoreline surveys and monitor surface water in the Blackstone River watershed - ongoing	Ambient water quality (chemical and bacterial), shoreline surveys, flow measurements, macroinvertebrate sampling	Comparative purposes; sampling design development	None
USGS – stream gage analysis and data collection - ongoing	Discharge and duration data, chemical, microbiological, and sediment	Comparative purposes; sampling design development	None
ACOE 1997 - Blackstone River Watershed Reconnaissance Investigation, Army Corps of Engineers New England District, Concord, MA.	Assessment of contaminated sediments, inventory of environmental restoration opportunities, and inventory of dams	Comparative purposes; sampling design development	None
Battelle 2000 – Blackstone River Feasibility Study and Ecological Risk Assessment (ERA), Duxbury, MA.	ERAs were completed for two impoundments in the watershed (Fisherville and Singing ponds), also, sediment and fish tissue samples were collected at three impoundments in the watershed (Fisherville, Singing, and Wildwood ponds)	Comparative purposes; sampling design development	None
ACOE – West Hill Dam Project - ongoing	Bathing beach water quality monitoring	Comparative purposes; sampling design development	None
MA DEP, EPA, URI, 2001 - Blackstone River Initiative	Assessment of base flow conditions - toxicity bioassays using effluent and sediment samples and some limited biological assessments with fish and macroinvertebrate species	Comparative purposes; sampling design development	None
City of Worcester – Phase I Storm Water Permit Requirements - ongoing	Dry and wet weather field screening of storm water outfalls; wet weather sampling at five outfall locations three times a year, plus instream sampling of two sites during the same wet weather events; and wet weather sampling of the mouth of the Old Mill Brook for fecal coliform and zinc during the spring and summer	Comparative purposes; sampling design development	DPW follows Standard Methods required by their EPA NPDES permit
MA DEP, DWM 1998 Water Quality Monitoring	Water quality and biological monitoring	Comparative purposes; sampling design development	None
SMART Monitoring - ongoing	Water quality monitoring	Comparative purposes; sampling design development	None

6.0 PROJECT OVERVIEW AND SCHEDULE

6.1 Overview of 2003 Blackstone River Watershed Monitoring

6.1.1 <u>River/Stream Monitoring</u>:

Water quality sampling will be conducted on five occasions from May through September at 21 locations. Samples will generally be grab samples collected using wade-in and bridge drop techniques, as approved in DWM Standard Operating Procedures (SOPs). At each station, field water quality measurements will be obtained using multiprobes. All water samples will be delivered for analysis to Wall Experimental Station (WES) in Lawrence, MA.

6.1.2 <u>Lake/Pond Monitoring</u>:

Lakes monitoring for Total Phosphorus TMDL development and watershed assessment will be conducted at six ponds.

Water quality sampling will be conducted three times over the summer (except multiprobe profiles which will be performed once in late summer). Water quality measurements will include temperature, pH, dissolved oxygen (DO), color, chloride, Secchi disk, chlorophyll a, and total phosphorus at a number of depths. Aquatic macrophyte mapping will be performed on one occasion, during the growing season, on each lake (MA DEP 2003a).

<u>Phosphorus Loading Study</u>: A special project will be conducted to estimate both non-point source and point source phosphorus loads to the Mill River (Harris and Spindleville river impoundments) during low flow conditions. This involves estimating the mass transport of phosphorus upstream and downstream of the Hopedale WWTP. See Element 8.1.2.

6.1.3 <u>Benthic Macroinvertebrate and Aquatic Habitat Monitoring</u>: (***subject to revision***)

Benthic macroinvertebrate communities, their associated aquatic habitats, and periphyton may be sampled and assessed at 15 stations on one occasion. The macroinvertebrate sampling and processing procedures are described in DWM SOP 39.1, and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). The macroinvertebrate collection procedure utilize kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream. Macroinvertebrate sampling activities and accompanying habitat assessments are conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (MA DEP 2003b). Macroinvertebrate functional feeding group, community composition, pollution tolerance, and abundance metrics are calculated to determine aquatic life use status (MA DEP 2003b).

6.1.4 <u>Fish Toxics Monitoring</u>: (***subject to revision***)

Fish toxics monitoring may be conducted at Eddy, Singletary, and Manchaug ponds. Fish are collected from each waterbody on one occasion. Edible fillets are analyzed for selected metals, PCBs, and organochlorine pesticides.

6.1.5 <u>Fish Population Monitoring:</u> (***subject to revision***)

Fish assemblages will be sampled on one occasion at up to 20 tributary sites in the Blackstone River Watershed (a subset of the benthic macroinvertebrate sampling stations), using approved DWM SOPs. Division of Fish and Wildlife (DFW) will also be performing population surveys in the Blackstone River Watershed in 2003.

6.2 Monitoring Schedules

See **Table B3**.

Table B3. Project Schedules for 2003 Blackstone River Watershed Monitoring (*biological monitoring subject to revision*)

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
River/Stream Surveys				
Coordination, meetings, reconnaissance, river/stream sampling plan development, etc.	November, 2002	February, 2003	Draft sampling plan; meeting notes, etc.	February, 2003
Draft sampling plan review and approval	January, 2003	February, 2003	Internal DWM concurrence on sampling plan	February, 2003
2003 DWM Monitoring QAPP	February, 2003	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Water quality sampling surveys (5 rounds)	May, 2003	September, 2003	Field data; lab samples to WES	May-Sept., 2003
Data QA/QC review and validation	January 2004	March 2004	2003 Data Validation Report	March 2004
Blackstone Watershed Assessment Report	2004	2005	Blackstone River Watershed Assessment Report	2005
Lake Surveys				
2003 Lakes Baseline TMDL QAPP development, review and approval	November, 2002	March, 2003	2003 Lakes Baseline TMDL QAPP	March, 2003
Lakes sampling surveys (3 rounds)	June, 2003	September, 2003	Field data; lab samples	June-Sept., 2003
Aquatic plant surveys	June, 2003	September, 2003	Field data; plant maps	October, 2003
Preliminary survey report	December, 2003	January, 2004	Technical memorandum	January, 2004
Draft TMDL Reports for Blackstone waterbodies	January 2005	December 2005	Draft TMDL Reports	December 2005
Benthic Macroinvertebrate/Aquatic Habitat Surveys (*biological monitoring subject to revision*)				
2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP development, review and approval	November, 2002	February, 2003	2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP	March, 2003
Benthic/Habitat sampling surveys (1 round)	June, 2003	September, 2003	Field data; benthic samples to DWM	September 2003
Macroinvertebrate/Habitat Assessment Technical Memorandum	October, 2003	2004	Macroinvertebrate/Habitat Assessment Technical Memorandum	2004
Blackstone River Watershed Assessment Report	2004	2005	Blackstone River Watershed Assessment Report	2004
Fish Population Surveys				
2003 DWM Monitoring QAPP	February, 2003	April, 2002	2003 DWM Monitoring QAPP	April, 2003
Fish Population sampling surveys (1 round)	July-Sept., 2003	July-Sept., 2003	Field data	September, 2003

Table B3 (cont). Project Schedules for 2003 Blackstone River Watershed Monitoring (*biological monitoring subject to revision*)

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
Fish Population data review, analysis and preliminary reporting	September, 2003	2004	Fish Population Technical Memorandum	2004
Blackstone River Watershed Assessment Report	2004	2005	Blackstone River Watershed Assessment Report	2005
Fish Toxic Surveys (*biological monitoring subject to revision*)				
2003 DWM Monitoring QAPP	February, 2003	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Fish Toxics sampling surveys (1 round)	June-July, 2003	June-July, 2003	Field data; lab samples	July, 2003
Fish Toxics data review and preliminary report	September, 2003	2004	Fish Toxics Technical Memorandum	2004

7.0 DATA QUALITY OBJECTIVES and PERFORMANCE CRITERIA

Monitoring data for the Blackstone River watershed will meet the specific data quality objectives (DQOs) outlined in Element 13. Not meeting these planned DQOs may subject project data to qualification or censoring during post-monitoring quality control review (see Elements 16-19 for discussion of data assessment and validation).

8.0 SAMPLING DESIGN

For a description of DWM's general approach to watershed monitoring, see the Executive Summary.

8.1 Design Rationale for 2003 Blackstone River Watershed Monitoring

8.1.1 River/Stream Monitoring:

Consistent with DWM's general approach to watershed monitoring to meet defined programmatic objectives, water quality surveys on streams/rivers in the Blackstone River Watershed will be conducted once a month in May, June, July, August and September in 2003 at a total of 21 locations. Field measurements for DO (typically pre-dawn), temperature, conductivity, pH, will be performed, grab samples for analytical parameters identified in **Table B4** (via wade-in or bridge drop) will be taken and streamflow measurements will be calculated at designated stations.

Additionally, a summertime Phosphorus Loading Study will be conducted on the Mill River to estimate the retention of phosphorus by impoundments and wetlands downstream of point source discharges.

See **Table B4** for river/stream sample station IDs, descriptions, parameters and frequencies, and **Figure B2** for sample site locations. Sampling rationales (and specific objectives, as identified in Element 5.1, met) for specific river segments proposed for 2003 monitoring are as follows:

Kettle Brook (Segment MA51-19)
This Class A public water supply was assessed as supporting the Aquatic Life and Asthetics Uses in the 1998 MA DEP's Water Quality Assessment Report. In 1998, DWM staff conducted water quality monitoring and a benthic survey on this segment. The sampling station was used as the regional reference for the benthic survey and exhibited rich species diversity with a well balanced community. There was too little bacteria data collected in 1998 to assess the recreational uses, therefore, this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station KB10 is being proposed to monitor the water quality in this segment. The station is located downstream from Earle Street in Leicester, MA. **Objectives 1 and 4**

Kettle Brook (Segment MA51-01)
This segment of Kettle Brook is a Category 5 water on the draft 2002 Integrated List for unknown causes, nutrients, organic enrichment/low DO, and pathogens. The 1998 Water Quality Assessment Report recommended additional sampling to evaluate the recreational uses and to isolate potential sources for bacteria inputs. In the 1998 survey, bacteria counts were elevated at the outlet of Leesville Pond, Worcester, MA; however, the data set was too limited to make an assessment. NPS pollution and rapid flow fluctuations associated with storm events are also suspected to impact this segment due to high coverage of this are with impervious surfaces. The 1998 Water Quality Assessment Report recommended a continuation of monitoring bacteria levels in this segment and to evaluate the effectiveness of the City of Worcester's DPW Storm Water Management Program. This station is also an historic biological monitoring station; it was sampled in 1973, 1977, 1985, and 1998. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station KB02, located at the Oxford Street Bridge at the outlet of Leesville Pond, Worcester MA is being proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Dark Brook (Segment MA51-16)
This segment is a Category 5 water on the draft 2002 Integrated List for unknown causes. Dark Brook runs through dense commercial development. There was too little bacteria data collected in 1998 to assess the recreational uses, therefore this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season). This station is also an historic biological monitoring station; it was sampled in 1998.

- Sample station RB01, downstream of Route 12, Auburn, MA is proposed to monitor the water quality. **Objectives 1 and 4**

Middle River (Segment MA51-02)
This segment is a Category 5 water on the draft 2002 Integrated List for unknown causes, unknown toxicity, metals, nutrients, pH, organic enrichment/low DO, pathogens, and turbidity. During the 1998 DWM survey, elevated bacteria counts were detected at sampling station BLK00 (west at the northern most crossing of Millbury Street, Worcester). The City of Worcester DPW is permitted (MAS010002) to discharge from all new or existing storm sewers into Coes Pond and the Middle River. Additionally, the Middle River runs through downtown Worcester, a highly urbanized area, therefore there is a strong potential for NPS pollution. This station is also an historic biological monitoring station; it was sampled in 1977, 1985, and 1998. There was too little bacteria data collected in 1998 to assess the recreational uses, therefore this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BLK00, located west at the northern most crossing of Millbury Street, Worcester, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Beaver Brook (Segment MA51-07)
This segment is a Category 5 water on the draft 2002 Integrated List for unknown causes and pathogens. The City of Worcester DPW is permitted (MAS010002) to discharge from all new or existing storm sewers into Beaver Brook. Through the City of Worcester DPW's Storm Water Management Program, five illicit sewer connections were identified as discharging to Beaver Brook. All five of these connections were repaired between June and September 1999 (MA DEP 2001). The 1998 Water Quality Assessment Report recommended a continuation of monitoring bacteria levels in this segment and to evaluate the effectiveness of the City of Worcester's DPW Storm Water Management Program. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BB01, located upstream/Northwest of Park Avenue, Worcester, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Unnamed tributary - "Mill Brook" (Segment MA51-08)
This segment is a Category 5 water on the draft 2002 Integrated List for priority organics, metals, unionized ammonia, nutrients, organic enrichment/low DO, pathogens, oil and grease, taste, odor and color, suspended solids, and turbidity. The 1998 Water Quality Assessment Report recommended a continuation of monitoring bacteria levels in this segment and to evaluate the effectiveness of the City of Worcester's DPW Storm Water Management Program. The Worcester Combined Sewer Overflow Treatment Facility is permitted (MA0102997) to discharge screened and disinfected (chlorine) combined sewer overflow to "Mill Brook". This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station MB01, located upstream of Ballard Street, Worcester, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Blackstone River (Segment MA51-03)
This segment of the Blackstone River is a Category 5 water on the draft 2002 Integrated List for unknown toxicity, priority organics, metals, unionized ammonia, chlorine, nutrients, and organic enrichment/low DO. The Upper Blackstone Water Pollution Abatement District (UBWPAD), is permitted (MA0102369) to discharge treated wastewater to this segment of the Blackstone River. The Millbury WWTP is permitted (MA0100650) to discharge treated wastewater to this segment of the Blackstone River. The City of Worcester DPW is permitted (MAS010002) to discharge from all new or existing storm sewers into the Blackstone River. The 1998 Water Quality Assessment Report recommended a continuation of monitoring bacteria levels in this segment and to evaluate the effectiveness of the City of Worcester's DPW Storm Water Management Program. The following sampling stations were also historic biological monitoring stations; they were sampled in 1973, 1977, 1985, 1991, and 1998 (only BLK02 in 1998). The following sample sites may also provide data on the NPS pollution impact from the Route 146/Mass Pike construction project that is ongoing along this segment. These stations are proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BLK02, located upstream of McCracken Road, Millbury, MA is proposed to monitor the water quality in this segment.
- Sample station BS12, located approximately 100 meters downstream of Singing Dam, Sutton, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Quinsigamond River (MA51-09)
This segment is one of the two largest tributaries to the Blackstone River. Wyman-Gordon Company, Grafton (MA0004341) discharges via multiple outfalls to the river. The City of Worcester DPW is permitted (MAS010002) to discharge from all new or existing storm sewers to Lake Quinsigamond. There are no in-stream bacteria data available for this segment, however, the presence of illicit sewer connections discharging into Lake Quinsigamond is of concern. The 1998 assessment report

recommends monitoring bacteria levels to evaluate the effectiveness of the City of Worcester DPW Storm Water Management Program. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station QU05, located upstream of Pleasant Street, Grafton, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Blackstone River (Segment MA51-04)
This segment of the Blackstone River is a Category 5 water on the draft 2002 Integrated List for unknown toxicity, priority organics, metals, nutrients, organic enrichment/low DO, pathogens, taste, odor and color, suspended solids, and turbidity. The Grafton WWTP (MA0101311) and the Northbridge WWTP (MA0100722) are permitted to discharge treated wastewater to this segment of the Blackstone River. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BLK07, located upstream of Sutton Street, Northbridge, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Blackstone River (Segment MA51-05)
This segment of the Blackstone River is a Category 5 water on the draft 2002 Integrated List for unknown toxicity, priority organics, metals, nutrients, pH, pathogens, taste, odor, color, suspended solids, and turbidity. The Uxbridge WWTF (MA0102440) is permitted to discharge treated wastewater to this segment of the Blackstone River. The following sample station was also an historic biological monitoring station; sampled in 1977, 1985, and 1991. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BS16, located downstream from the outlet of Rice City Pond, Uxbridge, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Mumford River (MA51-13)
This segment of the Mumford River was sampled once during the DWM 1998 field season. This historic sampling site is located upstream from the Douglas WWTP (MA0101095) and Guilford of Maine, Inc. (MA0001538) discharges. The 1998 DEP DWM Biomonitoring Technical Memorandum recommended that a site investigation be conducted to determine the cause and impact of NPS pollution that was observed during the 1998 survey. The following sample station was also an historic biological monitoring station; it was sampled in 1973, 1977, 1985, 1991, and 1998. There was too little bacteria data collected in 1998 to assess the recreational uses, therefore this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station BLK09-8, located off of Manchaug Road (at the outlet of Grays Pond), East Douglas, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Mumford River (Segment MA51-14)
This segment is a Category 5 water on the draft 2002 Integrated List for metals, pH, organic enrichment/low DO and pathogens. The following sample sites are located downstream stream from the Douglas WWTP (MA0101095) and the Guilford of Maine, Inc (MA0001538) discharges. The following sample stations were also historic biological monitoring stations; they were sampled in 1973 and 1993 (only MF03A in 1993). These stations are proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station MF03A, located upstream of Gilboa Street, Douglas, MA, is proposed to monitor the water quality in this segment.
- Sample station MF07, located upstream of Depot Street, Uxbridge, MA, is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

West River (Segment MA51-11)
This segment is a Category 5 water on the draft 2002 Integrated List for pH, organic enrichment/low DO and pathogens. One bacteria sample was collected by DWM in 1998, the counts were above the surface water quality standards, however, the data was too limited to assess the recreational uses for this segment. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station WR12, located upstream of Glen Avenue, Upton, MA, is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

West River (Segment 51-12)
This segment is a Category 5 water on the draft 2002 Integrated List for metals, nutrients, pH, organic enrichment/low DO, and salinity/TDS/chlorides. The Upton WWTF (MA0100196) discharges to this segment of the West River; the facility was

upgraded in 1999 including decholrination. The 1998 water quality assessment report recommended that additional DO monitoring be conducted to determine if low DO conditions are frequent and prolonged. These stations are proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station WR03 is located upstream of East Hartford Avenue, Upton, MA, is proposed to monitor the water quality in this segment. **Objectives 1 and 4**
- Sample station WR05 is located upstream of Hecla Street, Upton, MA, is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Blackstone River (Segment MA51-06)
This segment of the Blackstone River is a Category 5 water on the draft 2002 Integrated List for priority organics, nutrients, pH, pathogens, taste, odor, color, suspended solids, and turbidity. The proposed sampling station (BS19) was also an historic biological monitoring station; it was sampled in 1991. This station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season

- Sample station BS19, located downstream from Bridge Street Dam, Blackstone, MA is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

Mill River (Segment MA51-10)
This segment is a Category 5 water on the draft 2002 Integrated List for priority organics and metals. The Hopedale WWTP (MA0102202) is permitted to discharge treated wastewater to this segment of the Mill River. One bacteria sample was collected by DWM in 1998, however, the data was too limited to assess the recreational uses for this segment, therefore this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season). The following sample stations were also historic biological monitoring stations; they were sampled in 1973 (only ML01in 1973), 1977, 1985, 1991, and 1998.

- Sample stations ML01 (located upstream of Route 16, Hopedale, MA) and BLK15-1 (located upstream of Summer Street (Park Street), Blackstone, MA) are located upstream and downstream, respectively, of the Hopedale WWTP. These stations are being proposed to bracket the effects of the WWTP's effluent discharge. Additionally, flow measurements will be taken (twice during the sampling season) at these two stations as part of the Total Phosphorus TMDL study. **Objectives 1, 2, and 4**

Muddy Brook (Undefined Segment)
This brook is located in the Mill River subwatershed. This station is being proposed as part of the Total Phosphorus TMDL study (see Appendix I). Additionally, flow measurements will be calculated (twice during the sampling season) at this station.

- Sample station MD01, located upstream of Bellingham Street, Mendon, MA, is proposed to calculate nutrient loadings to the Mill River. **Objective 2**

Peters River (Segment MA51-18)
This segment is a Category 5 water on the draft 2002 Integrated List for pathogens and metals. This segment is not assessed for any uses, therefore this station is proposed for a comprehensive water quality survey (5 sampling rounds throughout the season).

- Sample station PR01, located downstream of Route 126, Bellingham, MA, is proposed to monitor the water quality in this segment. **Objectives 1 and 4**

8.1.2 Lake/Pond Monitoring:

DWM will sample lakes that are listed as Category 5 in the draft 2002 Massachusetts Integrated List of Waters. The focus will be on lakes that are downstream of WWTPs. Additionally, a P-loading study will be conducted to assist the development of new NPDES permits and develop TMDLs.

Consistent with DWM's general approach to watershed monitoring and TMDL development, lake water quality surveys in the Blackstone River Watershed will be conducted once a month in July, August and September in 2003 at a total of six lakes. Due to limitations on time and resources, samples will be taken at one, deep-hole station. In order to increase the number of lakes visited using limited staff, multiprobe profiles for dissolved oxygen, temperature, conductivity, pH, and turbidity will be performed only once in August-September (not for each round). Grab samples for analytical parameters identified in **Table B4** will be taken on each of the three rounds. See **Table B4** for the list of ponds and inlets to be sampled, along with sample station IDs, descriptions, parameters and frequencies. For more detailed information of 2003 lake sampling, see the 2003 Baseline Lakes TMDL QAPP (CN 128.0).

To meet **Objective 2**, the following are the six lakes to be surveyed in the Blackstone River Watershed:

1) Manchaug Pond MA51091 (Douglas/Sutton, MA)
This 348-acre waterbody is included in the draft 2002 Integrated List for organic enrichment/low DO and noxious aquatic plants.

2) Sutton Falls MA51163 (Sutton, MA)
This 10-acre waterbody is included in the draft 2002 Integrated List for turbidity.

3) Lake Ripple MA51135 (Grafton, MA)
This 63-acre waterbody is included in the draft 2002 Integrated List for noxious aquatic plants.

4) Arcade Pond MA51003 (Northbridge, MA)
This 18-acre waterbody is included in the draft 2002 Integrated List for noxious aquatic plants.

5) Spindleville Pond MA51158 (Hopedale, MA)
This 12-acre waterbody is included in the draft 2002 Integrated List for priority organics and noxious aquatic plants. This pond is downstream from the Hopedale WWTP.

6) Harris Pond MA51058 (Blackstone, MA)
This 93-acre waterbody is included in the draft 2002 Integrated List for noxious aquatic plants. This pond is downstream from the Hopedale WWTP.

Phosphorus Loading Study for the Blackstone Watershed:
Conducted as part of Baseline Lakes TMDL monitoring, sampling for Total Phosphorus, Total Dissolved Phosphorus (TDP), and Chloride (as a conservative surrogate analyte) is proposed for two rounds (mid-June and late August) to account for two flow regimes in the Mill River (relatively high and low stream flows).

Spindleville and Harris Ponds are two impoundments of the Mill River in the Blackstone River Watershed that have been targeted for sampling due to presumed impacts from the Hopedale WWTP. Both ponds are on the draft 2002 Massachusetts Integrated List of Waters (category 5). Phosphorus is the pollutant of concern as it is presumably the limiting nutrient for the lakes. Permit limits for the Hopedale WWTP are currently set at 1.0 mg/l for phosphorus (with a maximum allowable flow of 0.588 MGD) with the permit due for renewal in 2004. Preliminary calculations suggest about 30% of the P load at Harris Pond could be attributed to the Hopedale plant at full permit conditions. The point source could similarly account for about 50% of the load to Spindleville Pond. See **Figure B1**.

Because of the nature of the lakes and available data, a full QUAL2 modeling effort is probably not appropriate. Because of the need to know how much of the P discharged from the WWTP actually reaches each lake and plant upgrades are likely to be expensive, supporting data is needed.

A summer P-loading study will attempt to estimate both non-point source loads and point source loads during low flow conditions of summer when impairments are most critical. The study will focus on retention of total phosphorus by reservoirs and wetlands downstream of the point sources to see how much of the mass of the point sources actually reaches each reservoir in Massachusetts. This involves a mass balance/flow study by measuring both flow and TP upstream, and downstream of the plants, and at various tributary points and points above and below wetland areas an in the reservoirs themselves. The fraction of TP taken up per mile of stream downstream of the discharges will be estimated, similar to a decay equation, in order to estimate how much of each point source enters each reservoir. This is proposed for two-three days in mid-June and two-three days in late August, hopefully at relatively high and low flows under stable flow conditions (see Appendix I of the Connecticut Lakes TMDL for example calculations).

The data will be used in a daily estimate of mass balance calculations for each segment of the Mill River downstream of the Hopedale plant. If the segment is a lake or reservoir, a comparison will be made to determine if input and output concentrations agree better with retention equations, or with simple exponential uptake. Calculations for river segments involve estimating the mass entering the segment (measured flow x concentration) and leaving the segment and add a mass estimated to be contributed by nonpoint sources. Estimates of non-point sources will be calculated based on an assumed concentration of total phosphorus typical of that type of land use multiplied by estimated inflow from the portion of the watershed contributing to the flow of that segment. These NPS estimates will be compared to NPS loads estimated from flow time concentration at tributaries upstream of the WWTP point source. The same measurements will be conducted with chloride to see how well this approach can predict the dilution of a conservative tracer.

If the difference between upstream inputs plus local non-point source inputs is greater than output mass of phosphorus, then the difference in mass will be calculated and converted to a fractional loss divided by the distance of the segment (e.g. a decay rate of 5.5% loss per km). After all segments losses (or unexplained gains) are calculated they will be plotted against river mile to determine if a stable uptake rate appears to be appropriate. If so, then a weighted average exponential uptake rate will be calculated for the entire river. Once this is done then the distance from the plants to the lakes will be determined and fractional contributions of the WWTP plants to each lake will be estimated (e.g. 52% of the WWTP TP reaches the pond). The entire procedure is repeated for the low flow event in August and another set of decay rates calculated. If they are not stable over flow regime, then the most conservative estimate will be used to set the TMDL. Summer loads (7Q10) will be calculated for each lake based on both point source and non-point source TP. Thus, the TMDL will probably be written as a monthly TMDL during summer when P limits are in effect at the treatment plants, along with a yearly total TMDL for phosphorus limits. Nitrogen species will be collected during normal river water quality sampling but not used in this P loading analysis.

The above data and analysis is enough for a simple tracking of phosphorus. See Figure B1 below for a diagram of the site locations. Assuming EPA or others later insist on a QUAL2-type study to simulate DO, chlorophyll a etc, a few additional key measurements will be taken which are needed as input data for QUAL2. Fortunately, most of the required measurements will be taken as part of the lakes and stream water quality work (chlorophyll a, TSS, nitrate, ammonium). Additional chemistry will include chloride measurements at all flow stations and at surface of lakes. Chloride is used as a conservative tracer to verify flow calculations for each segment. In addition, TKN, dissolved reactive P (DRP) and BOD (both 5 day and 21 day "ultimate") will be taken at an upstream site, from both WWTP discharges and at the most downstream site. Dissolved reactive P (preferably filtered immediately in the field or ASAP at WES depending on equipment availability) will be sent immediately to lab with bacteria samples. If EPA agrees to monitor the plants then perhaps they would agree to run the BODs.

Thus, all of the river water quality sites, with the exception of the inlet of Spindleville Pond and the WWTP discharge, are scheduled to be sampled, either as part of the Blackstone River monitoring or as part of the Baseline Lakes sampling. The study will require coordination of sampling by lakes, river water quality, and flow crews over a two-day period in June and August. Hopefully, EPA can be convinced to monitor TP and flow at the WWTPs one the day of sampling or DMR data can also be used.

Lake crews will sample the WWTP and obtain the WWTP flows for the day. Sampling should be done during stable flow conditions, preferably once at high flows and once at low flows. The time of travel from the WWTP to the Harris Pond on the state line is unknown but is probably on the order of 0.5-2 days. Thus, there should be no significant rainfall (nothing over 0.2 inch) for 5 days preceding the measurements and there should be no precipitation (slight drizzle OK) during the study. If flows are not predicted to be stable (+/-10% over the two days of flow measurements), then the entire set of sampling should be delayed a week or more as needed. Possibly another basin sampling could be switched with the Mill River for that week. Each sampling window could be pushed back 3 weeks if needed. Sampling is tentatively proposed for June and August.

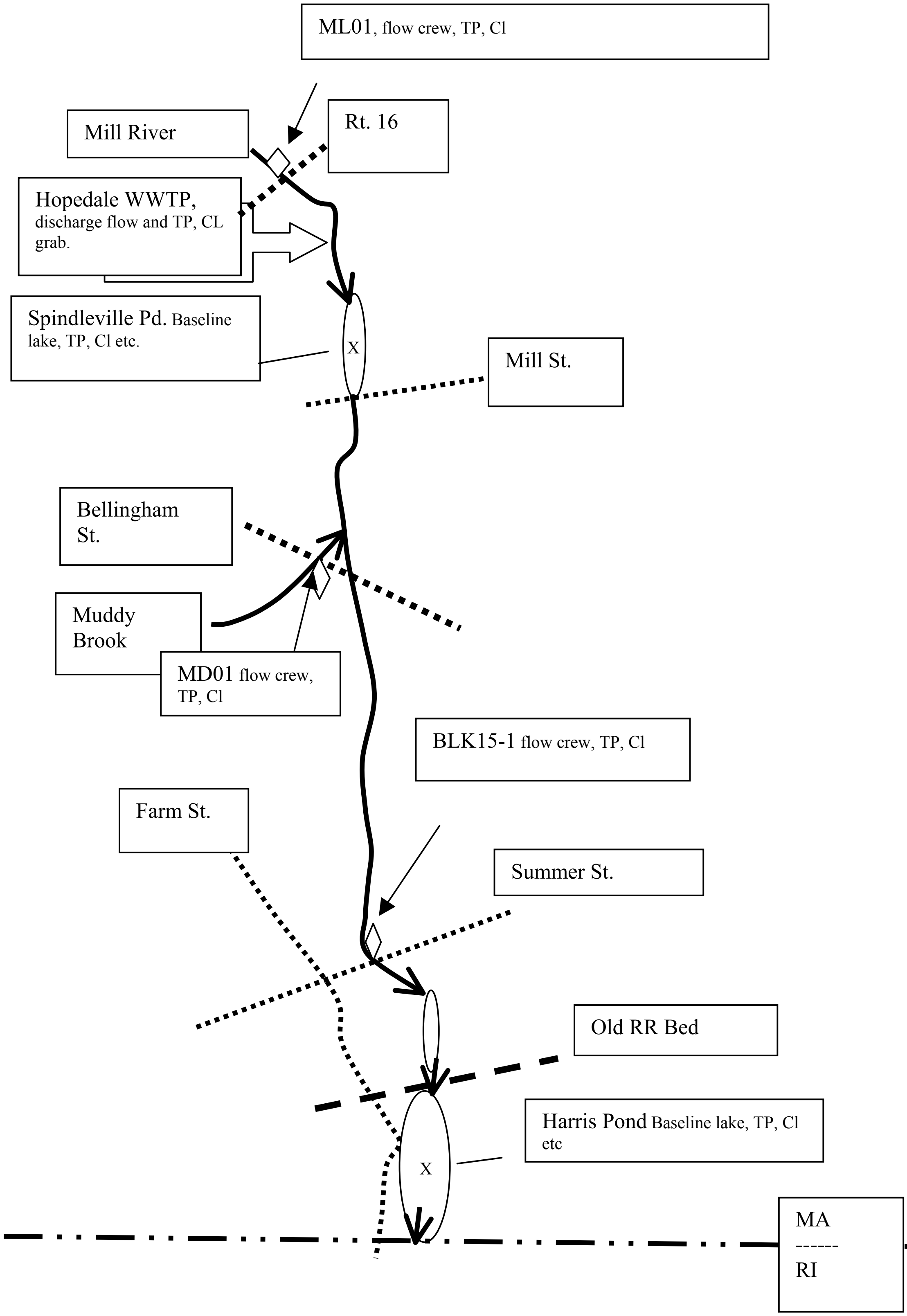

Figure B1. Schematic of Hopedale P Study Sample Sites. (Not to scale).

8.1.3 Benthic Macroinvertebrate and Aquatic Habitat Monitoring: ***(subject to revision)***

A total of 15 locations in the Blackstone River Watershed may be sampled (meeting **Objective 1**) for benthic macroinvertebrates and assessed for aquatic habitat, in order to investigate the effects of various point source and nonpoint source stressors (historical and current) on resident aquatic communities. Some stream segments are currently "unassessed" by DEP. Other segments may be re-evaluated to determine if water quality and habitat conditions have improved or worsened over time. Benthic macroinvertebrate data provides information necessary for making watershed-wide aquatic life use-support determinations required by Section 305(b) of the CWA. One round of monitoring (June-September, depending on schedule) may be performed.

See **Table B4** for potential benthic/habitat sample station IDs, descriptions, parameters and frequencies, and **Figure B2** for sample site locations.

8.1.4 Fish Population Monitoring: ***(subject to revision)***

Fish population sampling using electrofishing techniques as outlined in Section 6 will be conducted at up to 20 total river/stream tributary sites in the Blackstone River Watershed. These sites, meeting **Objective 1,** will coincide with some of the benthic sampling and habitat analysis sites. See **Table B4** for sample station IDs, descriptions, parameters and frequencies, and **Figure B2** maps for sample site locations.

Consistent with DEP's 5-year watershed cycle, the DFW is also sampling fish assembleges in selected tributaries in the Blackstone River Watershed in 2003. DWM has coordinated with DFW to avoid duplication of effort, and to ensure comparability of methods and data.

8.1.5 Fish Toxics Monitoring: ***(subject to revision)***

The 2003 fish toxics monitoring (meeting **Objective 3**) in the Blackstone River Watershed may consist of collecting fish on one occasion at three ponds:

1) Eddy Pond MA51043 (Auburn, MA)

2) Singletary Pond MA51152 (Sutton/Millbury, MA)

3) Manchaug Pond MA51091 (Douglas/Sutton, MA)

See **Table B4** for potential sample station IDs, descriptions, parameters and frequencies.

8.2 Sample Requirements (bottle type, preservatives and holding times):

See Element 11 for all field and analytical requirements for samples (method SOP, bottle type, preservative, holding times, etc.).

8.3 DWM OWMID #s:

The sample numbers to be used for Blackstone River Watershed 2003 River samples are as follows: **52-0110 up to 52-0500** as needed.

For Blackstone River Watershed 2003 Lakes sampling OWMIDs, see Lakes 2003 QAPP (CN 128.0)

Table B4. Sampling Sites, Descriptions, Parameters and Frequency for Blackstone River Watershed Monitoring

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
River/Stream Water Quality Surveys				
Kettle Brook (Segment MA51-19)	KB10	downstream from Earle Street in Leicester, MA	TP, NH_3-N, TSS, Fecal coliform and E. coli bacteria Multiprobe (DO; % Saturation; Temperature; pH; Depth; Specific Conductivity)	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn).
Kettle Brook (Segment MA51-01)	KB02	located at the Oxford Street Bridge at the outlet of Leesville Pond, Worcester MA	Same as above	Same as above
Dark Brook (Segment MA51-16)	RB01	downstream of Route 12, Auburn, MA	Same as above	Same as above
Middle River (Segment MA51-02)	BLK00	located west at the northern most crossing of Millbury Street, Worcester, MA	Same as above	Same as above
Beaver Brook (Segment MA51-07)	BB01	located upstream/Northwest of Park Avenue, Worcester, MA	Same as above	Same as above
Unnamed tributary - "Mill Brook" (Segment MA51-08)	MB01	located upstream of Ballard Street, Worcester, MA	Same as above	Same as above
Blackstone River (Segment MA51-03)	BLK02	located upstream of McCracken Road, Millbury, MA	Same as above	Same as above
	BS12	located downstream of Singing Dam, Sutton, MA	Same as above	Same as above
Quinsigamond River (Segment MA51-09)	QU05	located upstream of Pleasant Street, Grafton, MA	Same as above	Same as above
Blackstone River (Segment MA51-04)	BLK07	located upstream of Sutton Street, Northbridge, MA	Same as above	Same as above
Blackstone River (Segment MA51-05)	BS16	located at the outlet of Rice City Pond, Uxbridge, MA	Same as above	Same as above
Blackstone River (Segment MA51-06)	BS19	located downstream from Bridge Street Dam, Blackstone, MA	Same as above	Same as above
West River (Segment MA51-11)	WR12	located upstream of Glen Avenue, Upton, MA	Same as above	Same as above
West River (Segment 51-12)	WR03	located upstream of East Hartford Avenue, Uxbridge, MA	Same as above	Same as above

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
West River (Segment 51-12)	WR05	located upstream of Hecla Street, Uxbridge, MA	Same as above	Same as above
Mumford River (Segment MA51-14)	MF0A	located downstream of Gilboa Street, Douglas, MA	Same as above	Same as above
	MF07	located upstream of Depot Street, Uxbridge, MA	Same as above	Same as above
Mumford River (Segment MA51-13)	BLK09-8	located off of Manchaug Road (at the outlet of Grays Pond), East Douglas, MA	Same as above	Same as above
Mill River (Segment MA51-10)	ML01	located upstream of Route 16, Hopedale, MA	TP, NH_3-N, TSS, Fecal coliform and E. coli bacteria Multiprobe (DO; % Saturation; Temperature; pH; Depth; Specific Conductivity) Chloride (Cl), [Total Kjeldahl Nitrogen (TKN), Nitrate-Nitrite (NO_3+NO_2)-N, Biochemical Oxygen Demand (BOD), and Dissolved Reactive Phosphorus (DRP) collected once] Flow measurement	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn). Sampled twice for Phosphorus Loading study (in addition to the above parameters) Flow measurements calculated 2-3 times during monitoring season as part of Phosphorus TMDL survey.
	BLK15-1	located upstream of Summer Street (Park Street), Blackstone, MA	Same as above	Same as above
Muddy Brook (Undefined segment)	MD01	located upstream of Bellingham Street, Mendon, MA	Chloride (Cl) and TP Flow measurement	Sampled twice for Phosphorus Loading study Flow measurements calculated 2-3 times during monitoring season as part of Phosphorus TMDL survey.

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Peters River (Segment MA51-18)	PR01	located upstream of Wrentham Road, Bellingham, MA	TP, NH_3-N, TSS, Fecal coliform and E. coli bacteria Multiprobe (DO; % Saturation; Temperature; pH; Depth; Specific Conductivity)	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn).
Lake Surveys				
Manchaug Pond	MA51091	Douglas/Sutton, MA	Total Phosphorus, color, total alkalinity, chlorophyll a, chloride, Secchi Multiprobe (DO, %DO, pH, spec conductivity, temp, Chloride DO/T profile @0.5m, then 1m intervals to 0.5m above bottom); Aquatic plants (surveyed % cover, speciation)	Once a month for three months Once in late summer Once in late summer
Sutton Falls	MA51163	Sutton, MA	Same as above	Same as above
Lake Ripple	MA51135	Grafton, MA	Same as above	Same as above
Arcade Pond	MA51003	Northbridge, MA	Same as above	Same as above
Spindleville Pond	MA51158	Hopedale, MA	Same as above	Same as above
Harris Pond	MA51058	Blackstone, MA	Same as above	Same as above
Benthic/Habitat Surveys ***(subject to revision)***				
Blackstone River (Segment MA51-03)	*BLK01*	*Downstream from Millbury Street, Worcester, MA*	*Modified RBP III*	*Once*
	BLK02	*downstream from McCracken Rd., Millbury, MA*	*Modified RBP III*	*Once*
	BS12	*downstream from Singing Dam, off Chase Rd., Sutton, MA*	*Modified RBP III*	*Once*
Blackstone River (Segment MA51-04)	*BLK07*	*upstream from Sutton St., Northbridge, MA*	*Modified RBP III*	*Once*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Blackstone River (Segment MA51-05)	*BS16*	*downstream from Rice City Pond, Uxbridge, MA*	*Modified RBP III*	*Once*
	BLK12A	*upstream from Central St., Millville, MA*	*Modified RBP III*	*Once*
Kettle Brook (Segment MA51-19)	*KB10*	*downstream from Earle St., Leicester, MA*	*Modified RBP III*	*Once*
Kettle Brook (Segment MA51-01)	*KB02*	*downstream from Oxford St., Worcester, MA*	*Modified RBP III*	*Once*
Peters River (Segment MA51-18)	*PR01*	*downstream from Wrentham St., Bellingham, MA*	*Modified RBP III*	*Once*
Dark Brook (Segment MA51-16)	*RB01*	*downstream from Route 12, Auburn, MA*	*Modified RBP III*	*Once*
Mumford River (Segment MA51-13)	*BLK09-08A*	*downstream from Manchaug St., Douglas, MA*	*Modified RBP III*	*Once*
Mumford River (Segment MA51-14)	*MF03B*	*downstream from Douglas WWTP, East Douglas, MA*	*Modified RBP III*	*Once*
	MF05	*downstream from Gilford of Maine outfall, downstream from Gilboa Brook East Douglas, MA*	*Modified RBP III*	*Once*
West River (Segment MA51-12)	*WR01*	*upstream from West River Street, Upton, MA*	*Modified RBP III*	*Once*
Mill River (Segment MA51-10)	*BLK15-1*	*downstream from Park St., Blackstone, MA*	*Modified RBP III*	*Once*
Fish Population Surveys *(an estimated approximate 7-10 stations from the following list (TBD) may be sampled)* ***(subject to revision)***				
Kettle Brook	*TBD*	*TBD*	*Fish population (numbers of fish, species present, sizes)*	*Once*
Spring Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Chocolog River	*TBD*	*TBD*	*Same as above*	*Same as above*
Tinkerville Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Cedar Swamp Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Bating Brook	*TBD*	*TBD*	*Same as above*	*Same as above*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Happy Hollow Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Scadden Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Laurel Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Taft Pond Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Miscoe Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Center Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Miscoe Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Cook Allen Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Ellis Pond Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Axtell Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
West Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Ararat Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Tatnuck Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Scotts Brook	*TBD*	*TBD*	*Same as above*	*Same as above*
Fish Toxics Surveys ***(subject to revision)***				
Eddy Pond	*MA51043*	*Auburn*	*Heavy Metals (As, Cd, Pb, Se, Hg)* *Polychlorinated Biphenyls (PCBs)* *Organochlorine pesticides*	*Once*
Singletary Pond	*MA51152*	*Sutton/Millbury*	*Same as above*	*Same as above*
Manchaug Pond	*MA51091*	*Douglas/Sutton, MA*	*Same as above*	*Same as above*

2003 BLACKSTONE RIVER WATERSHED

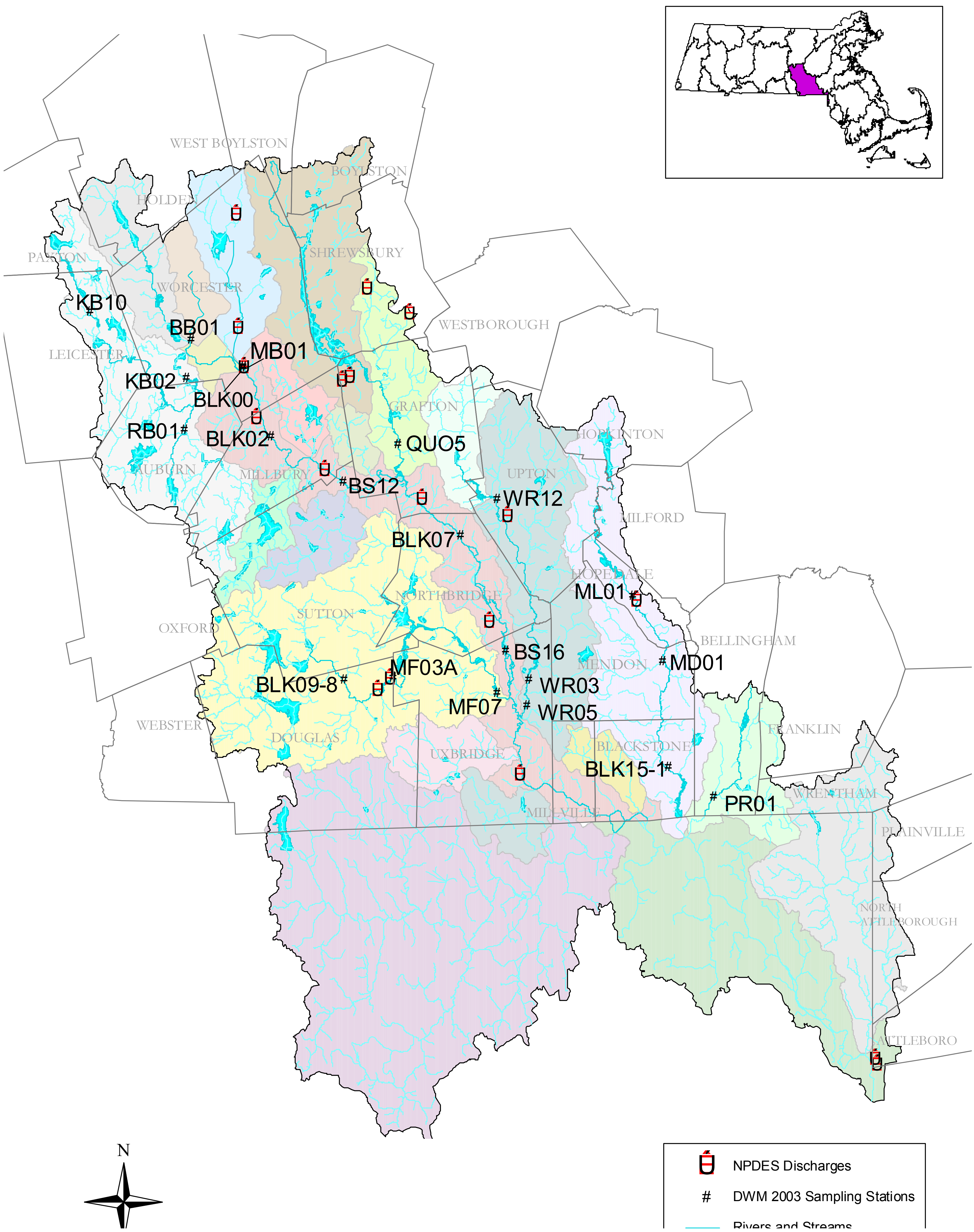

Figure B2. Blackstone River Watershed 2003 Monitoring Locations

Chicopee Watershed (2003 QAPP, Elements 5-8)

Slide Gate Control Structure at Quacumquasit Pond, Brookfield, Ma. (January, 2003)

5.0 PROJECT DEFINITION AND BACKGROUND INFORMATION

5.1 Goals & Objectives and Intended Use of the Chicopee River Watershed Data

The Division of Watershed Management's programmatic goals and strategy for 2003 monitoring in Massachusetts are discussed in the *Executive Summary*.

The goal of the Chicopee River Watershed Year 2 Survey is to obtain information at a total of 36 river/stream stations, two TMDL lakes, two fish toxic stations, and 14 stations for biological and habitat assessment that meets the following DWM programmatic objectives and watershed-specific sub-objectives.

Objective 1: Evaluate specific water bodies for support of designated uses (using Section 305(b) of the CWA), determine if State water quality standards are being met, and evaluate the level of impairment of CWA Section 303(d)-listed waterbodies.

► Conduct chemical and biological evaluations of previously un-assessed tributary and main-stem segments, as well as previously assessed river segments.

► Evaluate water quality and aquatic habitat around point source discharges, water withdrawals and known or suspected non-point sources of pollution.

Objective 2: Provide quality-assured data for use by DWM in developing Total Maximum Daily Loads (TMDLs) for State 303(d) listed waterbodies.

► Gather data for TMDL development for Quaboag and Quacumquasit Ponds, as well as for the Seven Mile, Quaboag, East Brookfield and Cranberry Rivers.

Objective 3: Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides).

► Assess screening-level surveys to determine fish body burdens of contaminants toxic to humans at the upper Quaboag River and Lake Lashaway (or the Ware River downstream from Powder Mill Pond) for potential public health concerns. ***(subject to revision)***

Objective 4: Provide quality-assured *E. coli* data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts freshwater criteria for *E. coli*.

5.2 Chicopee River Watershed Monitoring Locations

The Chicopee River Watershed 2002 monitoring locations are shown in **Figure C2**. More detailed, station-specific figures with listed analytes for each station are provided in separate document (CN 127.2).

5.3 Recent Historical and Current Data Collection Activities in the Chicopee River Watershed

Department of Environmental Protection Programs:

In 1998, monitoring of the Chicopee River Watershed was performed by DEP, Division of Watershed Management and the Central Regional Office. The selected 1998 monitoring parameters would largely become the basis for the now Strategic Monitoring and Assessment for River Basin Teams (SMART) program. (The goals of the SMART program are to document baseline water quality, estimate loadings at key locations, define long term trends in water quality, assess attainment of water quality standards, and provide data for other programs. Currently, five strategic stations in the Chicopee Watershed are sampled bimonthly throughout the five-year cycle to provide reference distributions, trends, seasonal information, and loadings. Parametric coverage includes, dissolved oxygen, pH, conductivity, alkalinity, hardness, chloride, total phosphorus, ammonia-nitrogen, nitrate-nitrite-nitrogen, total Kjeldahl nitrogen, temperature, total suspended solids, turbidity, aesthetics, and Microtox toxicity).

The DEP water quality monitoring effort in 1998 gathered information on rivers for fecal coliform, *E. coli* and Enterococci bacteria, fish tissue toxics, benthic macroinvertebrate communities, fish populations, periphyton and the physico-chemical parameters noted above. In addition, 93% of Chicopee Watershed lakes were visually assessed based on plant cover, algal abundance, water clarity (Secchi) and aesthetics. As a result of this monitoring, in combination with data collected from outside sources, 194 miles or 42% of the total river miles in the Chicopee River Watershed were assessed for the following uses; Aquatic Life, Fish Consumption, Primary and Secondary Contact Recreation and Aesthetics. Data are available in the *Chicopee River Watershed 1998 Water Quality Assessment Report* (MADEP 2001).

1998 DWM fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, PCBs and organochlorine pesticides. Two sites were selected following meetings that DWM staff held with the EOEA Chicopee Watershed Team, as well as DEP/WERO Bureau of Waste Site Clean up (BWSC) staff. The Chicopee River in the vicinity of the Uniroyal Hazardous Waste Site (station F0063) was targeted because of the possibility of PCB contamination from the site. The lower Quaboag River (station F0065) was selected because of the DFWELE trout stocking program, high fishing pressure, and DPH's Fish Consumption Advisory on the upstream impoundments (Quacumquasit Pond also known as South Pond and Quaboag Pond also known as North Pond). Data from this survey can be found in Appendix B of the *Chicopee River Watershed 1998 Assessment Report*.

Biomonitoring was also performed at seven river locations in the Chicopee Watershed and used to assess "Aquatic Life" use status. Data from this benthic macroinvertebrate monitoring can be found in Appendix C of the *Chicopee River Watershed 1998 Assessment Report*.

Metropolitan District Commission/Massachusetts Water Resources Authority Monitoring:

The Metropolitan District Commission, Division of Watershed Management has historically been legislatively mandated to manage and maintain a system of watersheds and reservoirs in order that clean water can be provided to the Massachusetts Water Resources Authority (MWRA). Specifically, Chapter 372 of the Acts of 1984 established the MWRA as in independent agency whose chief responsibility was the delivery and distribution of drinking water to approximately 2.5 million people across Massachusetts. The primary function of the MDC in this partnership has been to protect and monitor the watersheds.

Tributary water quality monitoring is used as a tool of the MDC watershed management program to assist with identifying sub-basins that may require special attention, enforcement actions, and to track overall trends in water quality. Twelve

Quabbin Reservoir tributaries and seventeen Ware River tributary stations are sampled biweekly. Samples are collected at the start of each work week regardless of weather conditions thereby providing a good representation of various flow conditions and pollutant loadings. Tributary water samples are analyzed at the MDC Quabbin laboratory for total and fecal coliform bacteria, alkalinity, pH, specific conductance and turbidity. Analysis is also performed quarterly for color, chloride, hardness and iron. Temperature and dissolved oxygen are determined in the field.

The reservoir monitoring program builds on a historic data set that is used to track the ecological health of the reservoir and to detect trends that may signal changes to the trophic status of the reservoir. Water quality data is collected monthly except during periods of adverse weather and ice conditions in the winter. Four sampling stations are routinely sampled. Water samples are analyzed at Quabbin laboratory for turbidity, color, pH, alkalinity, chloride, hardness and iron. Samples taken at the surface, 5-meter depth and intake depth are analyzed for total and fecal coliform bacteria. Physico-chemical samples are taken from mid-epilimnion and mid-hypolimnion during times of thermal stratification, and near the top and bottom during non-stratification. Wind, weather, reservoir conditions, air temperature and Secchi depth are recorded on each survey. Water column profiles of temperature, pH, dissolved oxygen, and specific conductance are measured in the field. Readings are taken every meter during times of thermal stratification, and every three meters when not stratified. Field data is stored digitally in a hand-held recorder and transferred to a computer database maintained at the Quabbin laboratory.

Grant funded projects:

1) *The Quaboag Watershed Sub-Basin: Assessment to Identify Potential Point and Non-Point Source Pollution*
Environmental Science Services, Inc. (ESS) under contract to the Massachusetts Department of Environmental Protection and in cooperation with the EOEA Chicopee River Watershed Team, used a combination of in-field water quality sampling and pollutant load modeling (P8) analysis to assess 30 individual watershed sub-basins in the Quaboag River Watershed. The goal of the investigation was to identify the basins likely to be contributing excessive non-point source pollution to the Quaboag River and to recommend additional confirmatory sampling in these basins. Ten sites were sampled during dry weather on 10/2/2000 and again on 11/9/2000. Sites were again sampled during wet weather on 10/5/2000. The field sampling conducted in support of the P8 modeling documented substantial increases in phosphorus and suspended solids in response to storm events. Sampling downstream of the Spencer Wastewater Treatment Plant indicated that the plant continues to be a substantial point source of nutrients to the watershed. (ESS, 2001)

2) Chicopee River Lakes and Ponds Stormwater Sampling (MWI 2003-02)
This project will conduct water quality sampling at 25 stormwater outfalls, tributary streams and/or other inputs to selected Category 5 (Massachusetts Integrated List of Waters) lakes and ponds in the lower Chicopee River Watershed. Results are intended to better document water quality conditions, quantify pollutant loadings and help identify sources of impairment. The sampling will target selected lakes and ponds mainly in the greater Springfield area where previous studies have documented water quality impairments caused by stormwater discharges. Tasks include Quality Assurance Project Plan (QAPP) production, three dry and five wet weather surveys at each selected stormwater outfall and other potential pollution sources (for pH, conductivity, temperature, turbidity, TSS, total phosphorus, nitrogen, fecal coliform bacteria, *E. coli* bacteria, and flow) and reporting on possible sources of water quality degradation.

3) *Conducting an Inventory of Stormwater Structures in the Chicopee Basin, with Water Quality Assessment of Selected Structures* (01-04/MWI).
This project involved two phases of work: the inventory of stormwater structures and the collection of stormwater samples for water quality assessment. A primary goal of this project was to identify potential stormwater problem areas within the Chicopee watershed. ESS, in consultation with the team leader and township Department of Public Works (DPW) officials, identified priority stormwater structures for inventory and further investigation. Priority stormwater structures are those structures discharging directly into a waterbody, such as a stream, river or a wetland associated with a waterbody. The general condition of each structure was noted as well as information on their maintenance if available. The physical characteristics of any dry weather flow including its coloration, odor, presence of foam, floating debris, visible turbidity, and sheens, was also recorded. Additionally, excess accumulated sediment at the storm drain structure was noted when present. Information was compiled in a Geographic Information System (GIS) database containing information on each structure (by community). Information collected in the stormwater inventory was used to prioritize stormwater structures for water quality collection. A second goal of this project was to assess water quality at “hot spot” stormwater structures that may be contributing to bacterial contamination in the watershed. The compiled database on the priority stormwater structures was used to identify twenty of these “hot spot” structures. ESS sampled water during dry weather conditions from 9 outfall locations on 9/19/2001 and from 14 outfalls on 12/12/2002. Temperature, pH, conductivity, dissolved oxygen and percent

saturation were recorded in the field. Samples were also collected and sent to Toxikon Labs Inc. to be analyzed for fecal coliform bacteria.

4) *Chicopee River Watershed: Identification of Likely Sources of NPS Pollution, 2002-2003 (* 02-06/MWI)
This project is designed to identify the location and causes of several previously identified or suspected sources of water quality impairment to the Chicopee River and its tributaries. The following three objectives serve to confirm previously identified or suspected problem areas, locate pollutant sources, and recommend potential solutions: 1) sampling and analysis will be performed for water quality at 20 selected locations during dry and wet weather conditions. Samples will be analyzed for fecal coliform, *E. coli*, total suspended solids (TSS), total Kjeldahl nitrogen (TKN) and total phosphorus in the laboratory; and pH, DO, specific conductance, turbidity, and temperature in the field. Secondary sampling or "bracketing" locations may be selected for follow-up sampling to more thoroughly investigate sub-drainage areas of concern and to isolate potential sources of pollution. 2) sources of water quality impairment will be determined based upon a combination of previously collected data and new data. Data will be supplemented by field reconnaissance efforts to recommend site-specific Best Management Practices (BMPs) for improving water quality. 3) P8 model verification. Data obtained during this project's field sampling will be used to evaluate whether the P8 modeling effort conducted by ESS in 2000-2001 was able to accurately predict, in a relative sense, conditions observed in the field. Specifically, nine sub-basins modeled in the 2000-2001 study will be selected, including three predicted by the P8 model to have impaired water quality, three predicted to have "clean" water quality, and three suspected to possess intermediate conditions. These basins will be closely examined to determine whether the levels of the modeled parameters can predict those actually recorded in the basins during the 2002 sampling program.

Surface water samples from twenty (20) sites within the Chicopee River watershed will be taken and analyzed for fecal coliform, *E. coli*, TKN, total phosphorus, and TSS. In addition, field-measured parameters including turbidity, DO, specific conductance, temperature, pH, and flow rate will be assessed. Berkshire Enviro-Labs, Inc will conduct the bacterial analysis using the membrane filtration method (mTEC), and will also conduct analysis for TSS, total phosphorus and TKN. The 20 in-stream sampling sites (Figure 1, Table 1) will be monitored a total of six times during the spring, summer and fall of 2002, targeting three dry weather and three wet weather dates per site. A Geographic Information Systems (GIS) database will be created that will delineate the respective upstream sub-basin for each sample location.

5) *Chicopee River Watershed Basin Assessment 1999-04/604, August 2000-June 2002*
The Pioneer Valley Planning Commission (PVPC) conducted a sub-basin assessment of stormwater infrastructure, existing water quality data, and local stormwater regulations for the lower Chicopee River watershed. The purpose of the project was to provide watershed stakeholders with a comprehensive picture of current stormwater management techniques within the project area and to assist the municipalities in meeting the EPA's NPDES Phase II Minimum Control Measures. The following tasks were utilized to accomplish this goal:

- ✓ Identification and mapping of stormwater infrastructure
- ✓ Identification, mapping, assessment, and organization of stormwater Best Management Practices (BMPs).
- ✓ Creation of a database of existing water quality monitoring data and low flow data within the study area
- ✓ Review and inventory of local stormwater bylaws and ordinances.

Volunteer Monitoring Programs

The Chicopee River Watershed Council is a community-based citizens' advocacy organization working for a better river environment. Their goals are to increase awareness and appreciation of the rivers in the Chicopee basin, advocate and encourage wise use of the river and its adjoining lands, actively participate in long range planning for the river and land along its banks, and promote restoration and conservation of the river's ecosystems and wildlife habitats. They encourage participation in the Council by holding regular meetings and sponsoring activities related to the watershed.

5.4 Data Gaps

The main data gap throughout the Chicopee River Watershed is a lack of geographic coverage in data collection necessary to perform complete and accurate water quality assessments. Additionally, there is a lack of quality data that can be used to determine sources of pollution. Wet weather surveys, which can help distinguish between pollution from stormwater or combined sewer overflows and that from illicit or failing septic and sewer systems, are another data gap that cannot be easily remedied. Staffing, budget and laboratory scheduling are the main obstacle for the collection of wet weather samples.

Based on perceived needs for additional information in the Chicopee Watershed, the following monitoring actions can be defined:

- ✓ Collect baseline water quality data for the lower Chicopee River (PVPC 2002). Limited water quality data for the first two segments of the Chicopee River (MA36-22 and MA36-23) exists from 1990 – present.
- ✓ Collect bacteria data during dry and wet weather monitoring to evaluate the effectiveness of Springfield, Chicopee and Palmer's CSO abatement programs (PVPC 2002).
- ✓ Collect baseline data for the major tributaries to the Chicopee River (PVPC 2002).

In 1999, the Massachusetts Water Resources Commission (MWRC), which sets water policy for Massachusetts, directed an interagency committee to define a stressed river basin. A stressed basin is defined by MWRC as a basin or sub-basin in which the quantity of streamflow has been significantly reduced, or the quality of the streamflow is degraded, or the key habitat factors are impaired. The stressed basin classification is intended to flag areas which may require a more comprehensive and detailed review of environmental impacts or require additional mitigation. In developing a definition of stressed basins the committee produced an outline of the information which would identify an area as stressed, and an interim list of environmentally vulnerable (stressed) basins. Stressed areas were determined by comparing low flow statistics for 67 rivers in 23 of the 27 major river basins (Gartland 2001). This stressed basin analysis demonstrated that the Ware River in the vicinity of Barre is highly stressed. The 1998 Chicopee River Basin Water Quality Assessment Report also indicated that the frequency of low dissolved oxygen and percent saturation as well as elevated temperatures recorded for segment MA36-27 (which coinside with low stream flow measurements) were cause to assess the Aquatic Life Use as "Partial Support" for the upper 1.7 miles of this reach and "Alert Status" for the lower 2.9 mile reach of the segment. An investigation into the status of flow regulation at three upstream dams (namely, Barre Falls Dam, Cold Brook Dam and Mare Meadow Dam) should be conducted and complemented by macroinvertebrate and fish population and habitat assessments in this section of the Ware River.

Table C1. Summary of Recent Historical Data for the Chicopee River Watershed

Data Source (Originating Organization, Report Title and Date)	Data Collection Type	How Data Will Be Used	Limitations on Data Use
DEP-DWM (1998) and CERO(SMART) (1999-present) *Chicopee River Watershed 1998 Assessment Report*.	temperature, pH, dissolved oxygen, conductivity, turbidity, flow, total suspended solids, total phosphorus, nitrate-nitrite, ammonia, TKN, alkalinity, hardness, chlorides, Microtox toxicity, aesthetics	- document baseline water quality - estimate loadings at key locations - define long term trends in water quality - Sampling plan design - 305(b) assessment	No bacteria sampling for CERO/SMART data
The Quaboag Watershed Sub-Basin: Assessment to Identify Potetial Point and Nonpoint Source Pollution, Environmental Science Services, Inc. DEP Project No. 00-04/MWI August 24, 2001	temperature, pH, dissolved oxygen, conductivity, turbidity, flow, total suspended solids, total phosphorus, nitrate nitrogen, ammonia, TKN, total alkalinity	Sampling plan design, 305(b) assessment	Unknown at this time
Chicopee River Watershed: Identification of Likely Sources of NPS Pollution, 2002-2003, Environmental Science Services, Inc. DEP Project No. 02-06/MWI ESS will sample and analyze water quality at 20 selected locations during dry and wet weather conditions	fecal coliform, *E. coli*, total suspended solids (TSS), total Kjeldahl nitrogen (TKN), pH, DO, specific conductance, turbidity, and temperature	Sampling plan design, 305(b) assessment	Unknown at this time
Conducting an Inventory of Stormwater Structures in the Chicopee Basin, with Water Quality Assessment of Selected Structures, Environmental Science Services, Inc. DEP Project No 01-04/MWI.	temperature, pH, conductivity, fecal coliform bacteria.	Sampling plan design, 305(b) assessment	Unknown at this time
Chicopee River Lakes and Ponds Stormwater Sampling, Environmental Science Services, Inc. DEP Project No. MWI 2003-0, This project will conduct water quality sampling at 25 stormwater outfalls, tributary streams and/or other inputs to selected 303d listed lakes and ponds in the lower Chicopee River Watershed.	pH, conductivity, temperature, turbidity, TSS, total phosphorus, nitrogen, fecal coliform bacteria, *E. coli* bacteria, and flow	Sampling plan design, 305(b) assessment	Unknown at this time

5.5 Impaired Waters

The objective of the Federal Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. To meet this goal the CWA requires States to develop information on the quality of their water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public. To this end, the EPA released guidance on November 19, 2001 for the preparation of an *Integrated List of Waters* that would combine reporting elements of both § 305(b) and § 303(d) of the CWA. The "integrated list" format allows States to provide the status of all their assessed waters in a single multi-part list. States choosing this option (like the Commonwealth of Massachusetts) has to list each water body or segment thereof in one of the following five categories:

1) Unimpaired and not threatened for all designated uses;
2) Unimpaired for some uses and not assessed for others;
3) Insufficient information to make assessments for any uses;
4) Impaired or threatened for one or more uses but not requiring the calculation of a Total Maximum Daily Load (TMDL);
5) Impaired or threatened for one or more uses and requiring a TMDL

Thus, waters listed in Category 5 constitute the 303(d) List. The remaining four categories are submitted in fulfillment of the requirements under § 305(b), essentially replacing the 305(b) Report format.

The new EPA guidelines also specify that each State submit a comprehensive assessment and listing methodology and detailed monitoring strategy as part of the integrated list package. Although the Consolidated Assessment and Listing Methodology (CALM) was published by the EPA in its final form in September 2002, it was generally not available in time for States to use it in developing their 2002 Integrated Lists. For this reporting cycle, Part 1 of the 2002 Massachusetts Integrated List of Waters and the individual watershed assessment reports prepared by the DWM provide the rationale and supporting information pertaining to how the assessments were made and what monitoring is needed in the future to fill data gaps. **Table C2** shows the 2002 Massachusetts Integrated List of Waters status for each Chicopee River Watershed waterbody proposed for sampling in 2003.

Table C2. Status of Water Quality Stations in the Chicopee River Watershed as Proposed in the Massachusetts 2002 Integrated List of Waters.

Waterbody	Location	Municipality	Segment ID	2002 Integated List of Waters Status
Chicopee River	Rt. 116 Bridge (alt sta. Rt. 33 bridge)	Chicopee	36-25	Category 5 - Pathogens
Chicopee River	West St. Bridge, Indian Orchard	Springfield	36-24	Category 5 - Pathogens
Chicopee River	Miller Street Bridge	Wilbraham	36-23	Category 5 - Pathogens
Chicopee River	Bridge St., Three Rivers	Palmer	36-22	Category 5 - Pathogens
Abbey Brook	Front Street bridge	Chicopee	new segment	TBD
Cooley Brook	Fuller Street bridge	Chicopee	new segment	TBD
Poor Brook	Main Street	Chicopee	new segment	TBD
Fuller Brook	Shawinigan Dr.	Chicopee	new segment	TBD
Fuller Brook	West St. @ Roy St.	Ludlow	new segment	TBD
Quaboag River	Palmer St. bridge	Palmer	36-17	Category 5 - Pathogens
Quaboag River	off Rt 67 @ USGS flow gage, SMART station	West Brimfield	36-16	Category 5 - Pathogens, taste, odor, color
Quaboag River	Gilbert Road bridge	West Warren	36-15	Category 2 - Attaining Aquatic Life and Aesthetics, other uses not assessed
Quaboag River	Davis Road	West Brookfield	36-14	Category 3 - no uses assessed
Quaboag River	Rt. 148 bridge	Brookfield	36-14	Category 3 - no uses assessed

Waterbody	Location	Municipality	Segment ID	2002 Integated List of Waters Status
Forget-Me-Not Brook	E. Brookfield Rd. bridge (north)	N. Brookfield	36-18	Category 2 - Attaining Aquatic Life and Aesthetics, other uses not assessed
Forget-Me-Not Brook	E. Brookfield Rd. bridge (south)	N. Brookfield	36-28	Category 5 - cause unknown, unknown toxicity, organic enrichment/low DO, taste, odor, color
Dunn Brook	Quaboag St. bridge	Brookfield	36-19	Category 3 - no uses assessed
East Brookfield River	Rt. 9 bridge	E. Brookfield	36-13	Category 3 - no uses assessed
East Brookfield River	Shore Rd. bridge	E. Brookfield	36-13	Category 3 - no uses assessed
Cranberry River	So. Spencer Rd.	Spencer	36-20	Category 5 -Chlorine
Spencer WWTP discharge	Treatment Plant off Rt. 9	Spencer	36-20	n/a
Seven Mile River	Cooney Road bridge	Spencer	36-11	Category 5 - Pathogens
Seven Mile River	Rt 9 bridge	Spencer	36-11	Category 5 - Pathogens
Seven Mile River	Rt 49 bridge	Spencer	36-11	Category 5 - Pathogens
Quaboag/South Ponds - flow gate	Lake Road	Brookfield/E. Brookfield	36-130 & 36-131	Category 5 - metals/exotic species
Ware River	Palmer St. bridge	Palmer	36-07	Category 2 - Attaining Aquatic Life, other uses not assessed
Ware River	Rt. 32 bridge - Gibbs crossing	Ware	36-06	Category 5 - Pathogens
Ware River	Upper Church St. bridge	Ware	36-05	Category 2 - Attaining Aquatic Life and Aesthetics, other uses not assessed
Ware River	Creamery Road bridge	New Braintree	36-05	Category 2 - Attaining Aquatic Life and Aesthetics, other uses not assessed
Ware River	Airport Road (alt. Hardwick Rd)	Barre	36-04	Category 2 - Attaining Aquatic Life, other uses not assessed
Ware River	off Rt. 122 @ USGS flow gage	Barre	36-03	Category 2 - Attaining Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation and Aesthetics, other uses not assessed
Ware River	New Braintree Rd. bridge, White Valley	South Barre	36-03	Category 2 - Attaining Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation and Aesthetics, other uses not assessed
Ware River	Cold Brook Road below Barre Falls Dam	Barre	36-27	Category 5 - Organic enrichment/low DO, thermal modifications
Swift River	Rt 181/State St.	Palmer, Ware, Belchertown,	36-10	Category 3 - no uses assessed
Swift River	off River Road	West Ware	36-09	Category 2 - Attaining Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation and Aesthetics, other uses not assessed

6.0 PROJECT OVERVIEW AND SCHEDULE

6.1 Overview of 2002 Chicopee River Watershed Monitoring

6.1.1 River/Stream Monitoring:

Water quality monitoring, including in-situ multi-probe measurements and/or grab samples, will be conducted at 36 locations in the Chicopee River Watershed on five occasions during the summer. Samples collected for total phosphorus, ammonia-nitrogen, total suspended solids and fecal coliform and *E. coli* bacteria will be simple grab samples collected using wade-in and bridge drop techniques, as approved in DWM SOPs. In-situ water quality measurements, including dissolved oxygen, percent saturation, temperature, pH, depth, and specific conductivity will be obtained in the field using multiprobe instruments. Grab water samples for bacteria, TSS and turbidity will be delivered to Severn Trent Laboratories in Westfield for analysis (tentative). All other samples will be delivered to the Senator William Wall Experiment Station in Lawrence, MA for analysis.

There are no planned wet-weather surveys (noticeable increase in stream flow) or stormwater monitoring events (NWS-forecasted minimum precipitation (e.g. 0.25 inches/24 hours, following a minimum 3 days of antecedent dry weather) for the Chicopee River Watershed in 2003. Flow measurement will be conducted at five-seven locations on at least three separate occasions as part of the Lakes TMDL P Loading Study (see Element 6.1.2 and 8.2).

6.1.2 Lake TMDL Monitoring:

Lake monitoring in the Chicopee Watershed to develop Total Maximum Daily Loading (TMDL) requirements will involve a Phosphorus Loading Study for Quaboag and Quacumquasit Ponds. Quaboag and Quacumquasit Ponds have been targeted for sampling due to presumed impacts from the Spencer WWTP. A year-long P-loading study is proposed to estimate both NPS loads and point source loads year round, but with greater emphasis on impacts during the summer growing season when impairments are most critical. See Element 8.2 for detailed information.

6.1.3 Biological Monitoring (including benthic macroinvertebrates, fish communities and aquatic habitat): (***subject to revision)***

Biological monitoring may be performed at up to 14 stations in the Chicopee River Watershed during 2003 on one occasion. Ten stations have been established to bracket point source discharges to assess water quality related impacts from direct discharges. Four stations were established below major dams to assess thermal and flow impacts to the biological community from hydromodification. Benthic macroinvertebrates are sampled and respective habitats assessed in accordance with the *Quality Assurance Project Plan for 2003 Benthic Macroinvertebrate Biomonitoring and Habitat Assessment, DWM CN 147.0*. Fish assemblage evaluation is performed in accordance with the *DWM Fish Population Monitoring SOP, CN 075.0*. Aquatic habitat scoring and general observations of in-stream and riparian zone habitat features are recorded as well. Benthic macroinvertebrate, fish population and habitat assessment information are useful to help determine aquatic life use status.

6.1.4 Fish Toxics Monitoring: (***subject to revision)***

Fish toxics monitoring may be conducted at the upper Quaboag River and Lake Lashaway (or the Ware River below Powder Mill Pond; TBD) in accordance with the programmatic *Fish Toxics Quality Assurance Project Plan, CN 096.0.* Fish are collected from each waterbody on one occasion. Fillet samples are analyzed for selected metals, PCBs, and organochlorine pesticides. Data are forwarded to the Massachusetts Department of Public Health to perform human health risk assessment for the consumption of fish from these waters.

6.2 Monitoring Schedules

See **Table C3**.

Table C3. Project Schedules for 2003 Chicopee River Watershed Monitoring

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
River/Stream Surveys				
Coordination, meetings, reconnaissance, river/stream sampling plan development, etc.	November, 2002	February, 2003	Draft sampling plan; meeting notes, etc.	February, 2003
Draft sampling plan review and approval	January, 2003	February, 2003	Internal DWM concurrence on sampling plan	February, 2003
2003 DWM Monitoring QAPP	February, 2003	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Water quality sampling surveys (5 rounds, 2 rounds inc. flow)	May, 2003	September, 2003	Field data; lab samples to WES	May-Sept., 2003
Data QA/QC review and validation	January 2004	March 2004	2003 Data Validation Report	March 2004
Chicopee River Watershed 2003 Assessment Report	2004	2005	Chicopee River Watershed 2003 Assessment Report	2005
Lake Surveys				
2003 Lakes Baseline TMDL QAPP development, review and approval	November, 2002	March, 2003	2003 Lakes Baseline TMDL QAPP	March, 2003
Lakes sampling surveys (3 rounds)	June, 2003	September, 2003	Field data; lab samples	June-Sept., 2003
Aquatic plant surveys	June, 2003	September, 2003	Field data; plant maps	October, 2003
Preliminary survey report	December, 2003	January, 2004	Technical memorandum	January, 2004
Draft TMDL Reports for Chicopee waterbodies	January 2005	December 2005	Draft TMDL Reports	December 2005
Benthic Macroinvertebrate/Aquatic Habitat Surveys ***(subject to revision)***				
2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP development, review and approval	November, 2002	February, 2003	2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP	March, 2003
Benthic/Habitat sampling surveys (1 round)	June, 2003	September, 2003	Field data; benthic samples to DWM	September 2003
Macroinvertebrate/Habitat Assessment Technical Memorandum	October, 2003	2004	Macroinvertebrate/Habitat Assessment Technical Memorandum	2004
Chicopee River Watershed 2003 Assessment Report	2004	2005	Chicopee River Watershed 2003 Assessment Report	2004

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
Fish Population Surveys ***(subject to revision)***				
2003 DWM Monitoring QAPP	February, 2003	April, 2002	2003 DWM Monitoring QAPP	April, 2003
Fish Population sampling surveys (1 round)	July-Sept., 2003	July-Sept., 2003	Field data	September, 2003
Fish Population data review, analysis and preliminary reporting	September, 2003	2004	Fish Population Technical Memorandum	2004
Chicopee River Watershed 2003 Assessment Report	2004	2005	Chicopee River Watershed 2003 Assessment Report	2005
Fish Toxic Surveys ***(subject to revision)***				
2003 DWM Monitoring QAPP	February, 2003	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Fish Toxics sampling surveys (1 round)	June-July, 2003	June-July, 2003	Field data; lab samples	July, 2003
Fish Toxics data review and preliminary report	September, 2003	2004	Fish Toxics Technical Memorandum	2004

7.0 DATA QUALITY OBJECTIVES and PERFORMANCE CRITERIA

Monitoring data for the Chicopee River watershed will meet the specific data quality objectives (DQOs) outlined in Element 13. Not meeting these planned DQOs may subject project data to qualification or censoring during post-monitoring quality control review (see Elements 16-19 for discussion of data assessment and validation).

8.0 SAMPLING DESIGN

For a description of DWM's general approach to watershed monitoring, see the *Executive Summary*.

8.1 Design Rationale for 2003 Chicopee River Watershed Monitoring

8.1.1 River/Stream Monitoring:

The proposed Chicopee River Watershed water quality monitoring in 2003 will be at 36 locations throughout the watershed. Station selection rationales are presented in **Table C4**, along with parameters, frequencies and station descriptions.

8.1.2 Lake/Pond Monitoring:

The P-loading Study for the Quaboag and Quacumquasit Ponds will have four components:

1) Baseline lake sampling during the summer as usual, including 3 monthly samples and one hydrolab profile.
2) Bi-monthly monitoring of inputs from point (Spencer WWTP) and non-point sources (tributary streams) and including surface grab samples from the ponds.
3) Stormwater collections of nutrient inputs (some of which may replace the bi-monthly sampling above).
4) Collection of ancillary WWTP samples during one summer sampling to collect data in support of a QUAL2 type model, in the event QUAL2 is needed.

The primary focus of the study is to determine how much phosphorus input to the ponds comes from point sources vs. nonpoint sources. The discharge from the Spencer WWTP is complicated by the fact that most of the discharge is lost to groundwater in the constructed wetlands and further retention of phosphorus may occur in wetlands en-route to the pond. The approach involves a mass balance/flow study in which both flow and TP upstream and downstream of the plants, and at the tributary sites, is measured. Estimates of the fraction of TP taken up per mile of stream downstream of the discharges, similar to a decay equation, will be made in order to estimate how much of each point source enters each reservoir. Because of the long retention time for Quacumquasit Pond, the study necessitates a year-round study of nutrient inputs, beginning in December of 2002. Bi-monthly sampling is proposed for the nutrient flux study, hopefully including relatively high and low flows under stable flow conditions and at least 3 major storms during spring and early summer will be attempted to be sampled (see Appendix of Connecticut Lakes TMDL for example calculations).

Quaboag and Quacumquasit Ponds are two large lakes in the Chicopee River Basin that have been targeted for sampling due to presumed impacts from the Spencer WWTP. Although not on the 1998 303d list, there is a citizen effort to get them listed on the 2002 Integrated List of Waters, Category 5 (303d). Phosphorus is the pollutant of concern as it is presumably the limiting nutrient for the lakes. The ESS (2000) report notes the after the upgrades to the Spencer WWTP between 1987 and 1990 the concentrations in Quaboag Pond dropped to 0.020mg/l and fell to 0.012 mg/l in Quacumquasit Pond in 1992. The Spencer treatment plant has a NPDES permit (MA0100919) with a permit flow rate of 1.08 mgd and growing season TP limit of 0.56 mg/l and winter limits of 0.75 mg/l. It should be noted that actual flows are approximately 0.5 mgd and most of this is lost, presumably to groundwater in the constructed wetlands on the site. The remaining ~0.2 mgd is discharged to a wetland bordering Cranberry Brook. The last years DMR reports indicate average discharge is 0.2 mgd with a concentration of 0.22 mg/l TP. Thus the discharge of phosphorus in the effluent is about 60 kg per year. It is expected that the new permit will require much more strict limits (as low as 0.2 mg/l which it is now meeting most days) on phosphorus discharge but the Town would like DEP to investigate other non-point sources of phosphorus as well. Recent reports suggest most of the P load is not due to the treatment plant, but rather is from non-point sources in the watershed. ESS completed a NPS study that sampled and modeled TP and other pollutants in the Quaboag sub-basin (ESS, 2001). Two more follow-up studies have just been completed by ESS and ESS has just been funded to study stormwater inputs to 5 TMDL lakes in the Chicopee basin (See **Table C1**).

Because of the nature of the lakes and the presence of rooted macrophytes, a full QUAL2 model run is probably not appropriate. However, the amount of P discharged from the WWTP that actually reaches each lake must be ascertained. Although the discharge from the treatment plant enters the Sevenmile River that is tributary to Quaboag Pond (about 3 week retention time), during periods of high flows water from Quaboag can back up into Quacumquasit Pond (a deep trout water habitat). EPA is also concerned about direct impacts of nutrients on Cranberry Brook and on the Sevenmile River. There are several previous studies on the system which will be reviewed. Plant upgrades are likely to be expensive and thus supporting data is needed.

The data will be used in a daily estimate of mass balance calculations for the Sevenmile River downstream of the Spencer WWTP. Separate calculations will be performed for inputs to Quacumquasit Pond that will focus on the effectiveness of the gate at reducing nutrient loading to the pond. For river segments, the mass entering the segment (measured flow x concentration) and leaving the segment will be calculated and a mass estimated to be contributed by nonpoint sources added. Non-point sources will be calculated based on an assumed concentration of total phosphorus typical of that type of land use multiplied by estimated inflow from the portion of the watershed contributing to the flow of that segment. The same measurements will be conducted with chloride as a conservative tracer to verify the model.

If the difference between upstream inputs plus local non-point source inputs is greater than output mass of phosphorus then the missing phosphorus mass will be calculated and converted to a fractional loss divided by the distance of the segment (e.g. a decay rate of 5.5% loss per km). After all segments losses (or unexplained gains) are calculated they will be plotted against river mile to determine if a stable uptake rate appears to be appropriate. If so, then a weighted average exponential uptake rate will be calculated for the entire river. Once this is done then the distance from the plant to the lakes will be determined and fractional contributions of the WWTP plant to each lake will be determined (e.g. 52% of Spencer WWTP TP reaches Quaboag Pond). The entire procedure is repeated for the flow event in each month and another set of decay rates calculated. If they are not stable over flow regime then the most conservative estimate will be used to set the TMDL. Summer loads (7Q10) will be calculated for each lake based on both point source and non-point source TP. Thus, the TMDL will probably be written as a monthly TMDL during summer when P limits are in effect at the treatment plants, along with a yearly total TMDL for phosphorus limits. Nitrogen species will be collected during normal river water quality sampling but not used in this P loading analysis.

The above data and analysis is enough for a simple tracking of phosphorus. Assuming the treatment plants or EPA later insist on a QUAL2-type study to simulate DO, chlorophyll a, dissolved reactive P, "ultimate" 21 day BOD, etc., a few additional key measurements will be taken which are needed as input data for QUAL2. Fortunately, most of the required measurements will be taken as part of the lakes and stream water quality work (chlorophyll a, TSS, nitrate-nitrite, ammonia-N). Additional chemistry will include chloride measurements at all flow stations and at surface of lakes. Chloride is used as a conservative tracer to verify flow calculations for each segment. In addition, TKN, dissolved reactive P and BOD (both 5 day and 21 day) will be taken at an upstream site, from both WWTP discharges and at the most downstream site. Dissolved reactive P samples will be filtered immediately in the field (preferred, subject to equipment availability) or sent on ice to the WES lab for same-day filtering. If EPA agrees to monitor the plant then perhaps they would agree to run the BODs for DWM.

Coordination with outside groups will be explored. Donna Grehl of the QQ Lake Association and Carl (Skip) Nielsen (who operates the gates) will be contacted to see if volunteers can assist in collection of stormwater samples. If so, pre-labeled sample bottles will be provided to the volunteers and the total phosphorus and chloride samples will be stored frozen until analysis (see 2003 Baseline Lakes QAPP for details). DWM will explore the possibility of coordinating stormwater sampling with the on-going ESS stormwater study of 5 ponds and see if Quaboag Pond can be included among the 5 selected ponds. Art Johnson, DWM will contact EPA to check on possibility of EPA sampling the treatment plant and to monitor the ponds for 24 hour DO during one day during the summer.

Most of the water quality sites are already scheduled to be sampled, either as part of the Chicopee monitoring, or as part of the Baseline Lakes sampling and possibly as part of the ESS study in development. The study will require coordination of sampling by lakes, river water quality, and flow crews over a two-day period in June and August. Hopefully, EPA can be convinced to monitor TP and flow at the WWTPs one the day of sampling or we can use DMR data, or request daily data from the WWTPs.

Flow measurements at 5 sites will be taken and flow records will be obtained for three additional stations. The five flow sites are placed at bridges at the following locations:

1) Sevenmile R. at Rt. 9; Read stage as height below bridge Rail at paint mark
2) Cranberry Brook at S. Spencer Rd.; Stage installed on southwest side.

3) Sevenmile at Rt. 49; Staff gauge installed on bridge read from south bank
4) Outlet of Lashaway at Rt. 9; Stage to be installed on dam discharge wall
5) Inlet to Quaboag Pond; Read stage as height below bridge Rail at paint mark

The three additional stations include:

1) USGS staff gauge reading upstream of project (Gage #01175670); compare to published stage/discharge curve
2) Daily final effluent flow from the Spencer WWTP (on request)
3) Back-flow notes over South Pond gate from Skip Nielsen (on request). This may involve the use of reading depth of water over gate and computing sharp crested weir estimate of flow and duration.

Note: There should be no significant rainfall (nothing over 0.2 inch) for 5 days preceding the measurements and there should be no precipitation (slight drizzle OK) during the flow study (does not apply to stormwater flows). If flows are not predicted to be stable (+-10% over the two days of flow measurements), then the entire set of sampling should be delayed a week or more as needed.

8.1.3 Fish Toxics Monitoring: ***(subject to revision)***

See **Table C4** for station-specific rationales and description of potential monitoring stations.

8.1.4 Benthic Macroinvertebrate, Habitat and Fish Community Monitoring: ***(subject to revision)***

See **Table C5** for description of potential monitoring stations.

8.2 Sample Requirements (bottle type, preservatives and holding times):

See Element 11 for all field and analytical requirements for samples (method SOP, bottle type, preservative, holding times, etc.).

8.3 DWM OWMID #s for the Chicopee:

The sample numbers to be used for the Chicopee River Watershed 2003 river samples are as follows: **36-0090-36-0500**.

For the Chicopee River Watershed 2003 Lakes sampling OWMIDs, see the Lakes 2003 QAPP (CN 128.0).

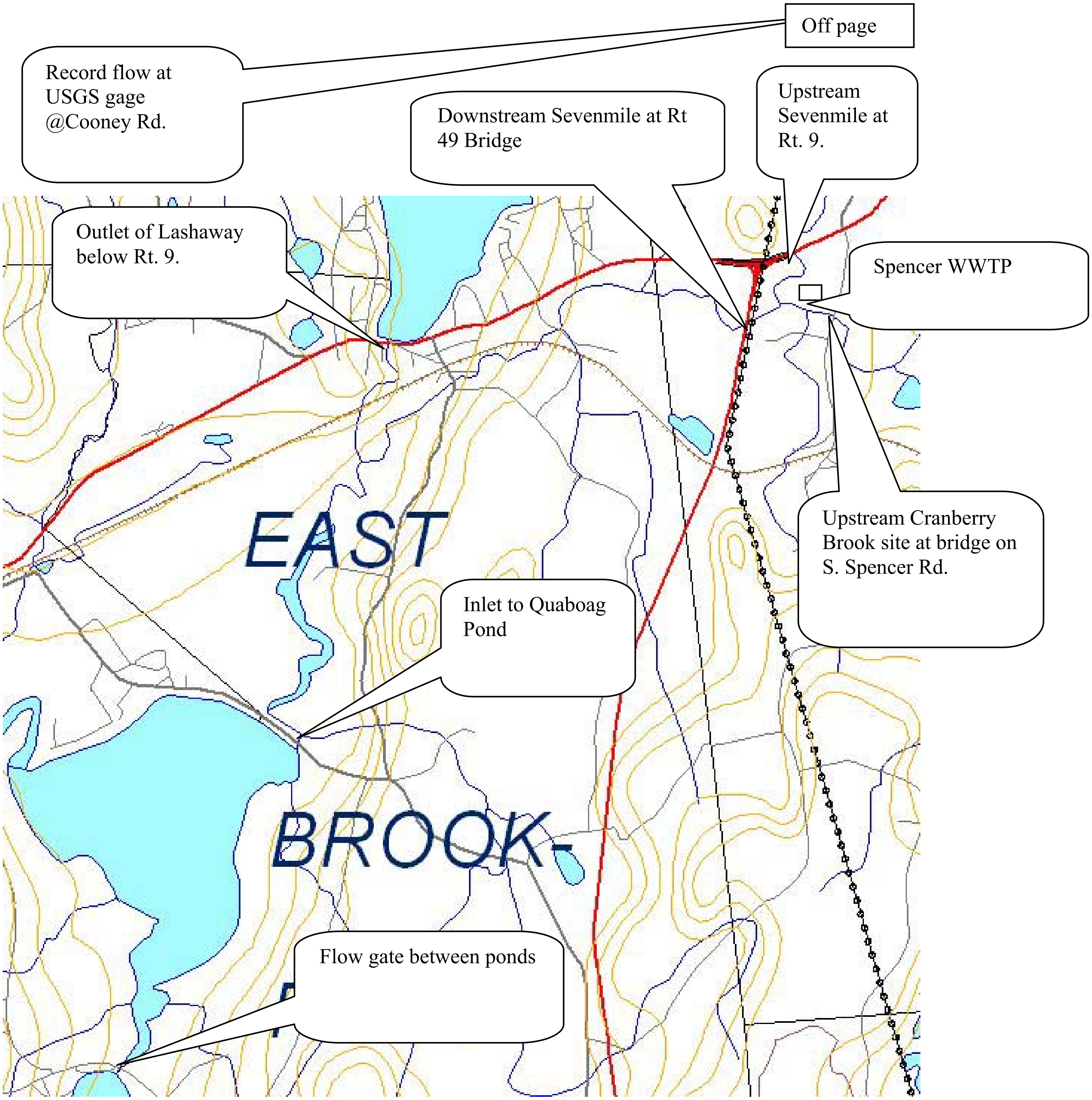

Figure C1. Lakes TMDL Quaboag/Quacumquasit Pond P Loading Study Sampling Locations

Table C4. Sampling Sites, Descriptions, Rationale, Parameters and Frequency for Chicopee River Watershed Monitoring

Waterbody	Station ID#	Site Description	Justification	Parameters	Frequency
River and Lake Monitoring					
Chicopee River	CH09	Rt. 116 Bridge (alt sta. Rt. 33 bridge), Chicopee	Not assessed in 1998/downstream from Uniroyal Hazardous waste site, Eastern Etching, several other NPDES dischargers/12 CSOs,	Multi-probe (DO, %DO, pH, specific conductance, temp.), Total Phosphorus (TP), Ammonia-Nitrogen (NH3-N), Total Suspended Solids (TSS), turbidity and bacteria (fecal coliform and *E. coli*)	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn).
Chicopee River	CH06	West St. Bridge, Indian Orchard; Springfield	Not assessed in 1998/ 13 CSOs	Same as above	Same as above
Chicopee River	CH02B	Miller Street Bridge, Wilbraham	Not assessed in 1998/downstream from Red Bridge Impoundment/FERC hydromodification issues for Aquatic Life	Same as above	Same as above
Chicopee River	CH01	Bridge St., Three Rivers; Palmer	Not assessed in 1998/ CSOs present/downstream from Palmer WWTP discharge/upstream from Red Bridge FERC	Same as above	Same as above
Abbey Brook	AB01	Front Street bridge, Chicopee	Previously unassessed/PVPC identified as "likely contributing contaminants having a negative effect on water quality and habitat"	Same as above	Same as above
Cooley Brook	COOL01	Fuller Street bridge, Chicopee	Previously unassessed/PVPC also identified as "likely contributing contaminants…"/downstream of Westover AFB	Same as above	Same as above
Poor Brook	POOR01	Main Street, Chicopee	Previously unassessed/PVPC also identified as "likely contributing contaminants…"/very urban-industrial disturbed watershed	Same as above	Same as above
Fuller Brook	FULL01	Shawinigan Dr., Chicopee	Previously unassessed/PVPC also identified as "likely contributing contaminants…"/Downstream from Chicopee Sanitary Landfill and the Mass Pike	Same as above	Same as above
Fuller Brook	FULL02	West St. @ Roy St., Ludlow	Previously unassessed/PVPC also identified as "likely contributing contaminants…"/upstream from Chicopee Sanitary Landfill and the Mass Pike	Same as above	Same as above
Quaboag River	QA09A	Palmer St. bridge, Palmer	Unassessed in 1998/CSOs	Same as above	Same as above
Quaboag River	QAONO	off Rt 67 @ USGS flow gage, SMART station, West Brimfield	Below Warren WWTP, mostly non-support 1998, high bacteria during dry conditions	Same as above	Same as above

Waterbody	Station ID#	Site Description	Justification	Parameters	Frequency
Quaboag River	QA06A	Gilbert Road bridge, West Warren	Above Warren WWTP/below Wm. E. Wright NPDES discharge, DWM bio in 1998, but no water quality in 1998	Multi-probe, TP, NH3-N, TSS, turbidity and bacteria (fecal coliform and *E. coli*)	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn).
Quaboag River	QAOBO	Davis Road, West Brookfield	Not assessed in 1998, below Brookfield Wire Co. NPDES discharge, SPENCER WWTP/TMDL station	Same as above	Same as above
Quaboag River	QA100	Rt. 148 bridge, Brookfield	Not assessed in 1998, above Brookfield Wire Co. NPDES discharge, SPENCER WWTP/TMDL station	Same as above	Same as above
Forget-Me-Not Brook	DB08	E. Brookfield Rd. bridge (north), N. Brookfield	Above N. Brookfield WWTP	Same as above	Same as above
Forget-Me-Not Brook	DB07	E. Brookfield Rd. bridge (south), N. Brookfield	Below N. Brookfield WWTP	Same as above	Same as above
Dunn Brook	DUN01	Quaboag St. bridge, Brookfield	Below N. Brookfield WWTP	Same as above	Same as above
Ware River	WA12	Palmer St. bridge, Palmer	Most downstream station on the Ware before Three Rivers, below 4 WWTPs and other NPDES discharges; only Aquatic Life assessed in 1998 (support)	Same as above	Same as above
Ware River	WA09A	Rt. 32 bridge – Gibbs crossing, Ware	Below Ware WWTP (& others), SMART station, CSO's	Same as above	Same as above
Ware River	WA06A	Upper Church St. bridge, Ware	Above Ware WWTP, below Gilbertville and Wheelwright WWTPs (& others)	Same as above	Same as above
Ware River	WAX	Creamery Road bridge, New Braintree	Above Gilbertville WWTP, below Wheelwright WWTP	Same as above	Same as above
Ware River	WAIR	Airport Road (alt. Hardwick Rd), Barre	Above Wheelwright WWTP, below Barre WWTP; mostly unassessed in 1998	Same as above	Same as above
Ware River	WA01	off Rt. 122 @ USGS flow gage, Barre	Just above Powder Mill Pond/Martone Landfill, below MDC intake, SMART station	Same as above	Same as above
Ware River	WAWV	New Braintree Rd. bridge, White Valley, S. Barre	Just below Powder Mill Pond/Martone Landfill	Same as above	Same as above
Ware River	WABF	Cold Brook Road below Barre Falls Dam, Barre	Above NPDES discharges, MDC monitors here, USGS flow gage here	Same as above	Same as above

Waterbody	Station ID#	Site Description	Justification	Parameters	Frequency
Swift River	SR02	Rt 181/State St., Palmer	Below Bondsville Dam, Old Bondsville Factory-hazardous waste site, CSO's , not assessed in 1998	Multi-probe, TP, NH3-N, TSS, turbidity and bacteria (fecal coliform and *E. coli*)	Single grab samples and Multiprobe for a total of 5 surveys (including pre-dawn).
Swift River	SR04	off River Road, W. Ware	SMART station, above Old Bondsville Factory hazardous waste site	Same as above	Same as above
Swift River	SR03	Cold Spring Road, Belchertown/ Ware	Above Old Bondsville Factory Hazardous Waste Site, below McGlaughlin Hatchery	Same as above	Same as above
East Brookfield River	EB04	Rt. 9 bridge, E. Brookfield	Outlet of Lake Lashaway, SPENCER WWTP/TMDL station, not assessed in 1998	TP, Chloride and staff gage reading Multiprobe, TP, NH3-N, TSS, Turbidity, Bacteria (fecal coliform and *E. coli*) Flow	Monthly Single grabs and Multiprobe for a total of 5 surveys (May through September). Three surveys (April, June and August)
Cranberry Brook	CRN01	So. Spencer Rd., Spenser	Above Spencer WWTP, SPENCER WWTP/TMDL station, not assessed in 1998	Same as above	Same as above
Seven Mile River	SM02	Rt. 49 bridge, Spenser	Below Spencer WWTP, SPENCER WWTP/TMDL station, not assessed in 1998	Same as above	Same as above
Seven Mile River	SM00	Cooney Road bridge, Spenser	Above Spencer WWTP, SPENCER WWTP/TMDL station, not assessed in 1998, SMART station	Same as above Also, record USGS gage height; use rating to determine flow	Same as above
Quaboag/South Ponds - flow gate	QP011	Lake Road, Brookfield/ E. Brookfield	Water flow & direction controlled	Same as above Also, flow-related information from volunteers	Same as above

Waterbody	Station ID#	Site Description	Justification	Parameters	Frequency
East Brookfield River	EB04A	Shore Rd. bridge, E. Brookfield	Inlet to Quaboag Pond, SPENCER WWTP/TMDL station, not assessed in 1998	Same as above (flow= bridge-board) Also, Dissolved Reactive Phosphorus (DRP), 5 and 21day BOD, Total Kjeldahl Nitrogen (TKN), Nitrate-Nitrite-Nitrogen (NO3-N)	Same as above Three surveys (April, June and August); same time as flow
Seven Mile River	SM01	Rt. 9 bridge, Spenser	Above Spencer WWTP, SPENCER WWTP/TMDL station, not assessed in 1998	Same as above	Same as above
Spencer WWTP discharge	SPEFF	Treatment Plant off Rt. 9, Spenser	SPENCER WWTP/TMDL station, sample the discharge before mixing	Same as above Also, get DMR/flow data from WWTP	Same as above
Quaboag Pond	QP	Deep hole	"Worst-case" summer conditions, and annual conditions, as part of P Loading Study	Multi-probe, TP, Chl a, aquatic plants, Secchi depth, apparent color) TP (only)	3X (July-September) Monthly
Quacumquasit Pond	QQP	Same as above	Same as above	Same as above	Same as above
Fish Tissue Contaminants		***(subject to revision)***			
Upper Quaboag River	*UQF*	*In the vicinity of Rt. 148 bridge, Brookfield*	*Data needed for middle segment. A fish advisory was issued for the upper segment, while none was warranted for the downstream segment.*	*Heavy Metals (As, Cd, Pb, Se, Hg), Polychlorinated Biphenyl (PCBs) congenors and arochlors, and Organochlorine pesticides*	*Once*
Lake Lashaway	*LSHF*	*In the vicinity of Rt. 9 bridge, E. Brookfield*	*MDFWELE stocked; high fishing pressure*	*Same as above*	*Same as above*

Table C5. Sampling Sites and Descriptions for Chicopee Benthic Macroinvertebrate, Habitat and Fish Population Monitoring *(subject to revision)*

Waterbody	Station ID#	Municipality	Site Description	Parameters	Frequency
Quaboag River	*36-QA06A*	*Warren*	*Downstream from Gilbert Road, above Warren WWTP*	*Modified RBP III (benthics) and fish species, numbers, sizes, condition*	*Once*
Quaboag River	*36- QAOX*	*Palmer/Brimfield*	*Off Rt. 67 approx 25 M upstream from USGS gage, below Warren WWTP*	*Same as above*	*Same as above*
Forget-me-not Brook	*36- DB08*	*N. Brookfield*	*E. Brookfield Rd, above N. Brookfield WWTP*	*Same as above*	*Same as above*
Forget-me-not Brook	*36- DB07*	*N. Brookfield*	*E. Brookfield Rd, below N. Brookfield WWTP*	*Same as above*	*Same as above*
Swift River	*36- SR04*	*Belchertown/Ware*	*Off River Road @ USGS Gage, above McGlaughlin Fish Hatchery*	*Same as above*	*Same as above*
Swift River	*36- SR03*	*Belchertown/Ware*	*Cold Spring Road, below McGlaughlin Fish Hatchery*	*Same as above*	*Same as above*
Ware River	*36-WA05*	*Hardwick*	*Downstream from Rt. 32,above Ware WWTP*	*Same as above*	*Same as above*
Ware River	*36-WA09A*	*Ware*	*Downstream from Rt. 32, Gibbs Crossing, below Ware WWTP*	*Same as above*	*Same as above*
West Branch Ware River	*36-WW01*	*Hubbardston*	*Below Bickford Pond Dam*	*Same as above*	*Same as above*
West Branch Ware River, unnamed tributary	*36-WWT01*	*Hubbardston*	*Below Mare Meadow Reservoir Dam*	*Same as above*	*Same as above*
Ware River	*36-WABF*	*Barre*	*Below Barre Falls Dam*	*Same as above*	*Same as above*
Ware River	*36-WA01*	*Barre*	*Below Cold Brook Spring Dam*	*Same as above*	*Same as above*
Seven Mile River	*36-SM01*	*Spencer*	*Route 9 Bridge, above Spencer WWTP*	*Same as above*	*Same as above*
Seven Mile River	*36-SM02*	*Spencer*	*Route 49 Bridge, below Spencer WWTP*	*Same as above*	*Same as above*

2003 CHICOPEE RIVER WATERSHED

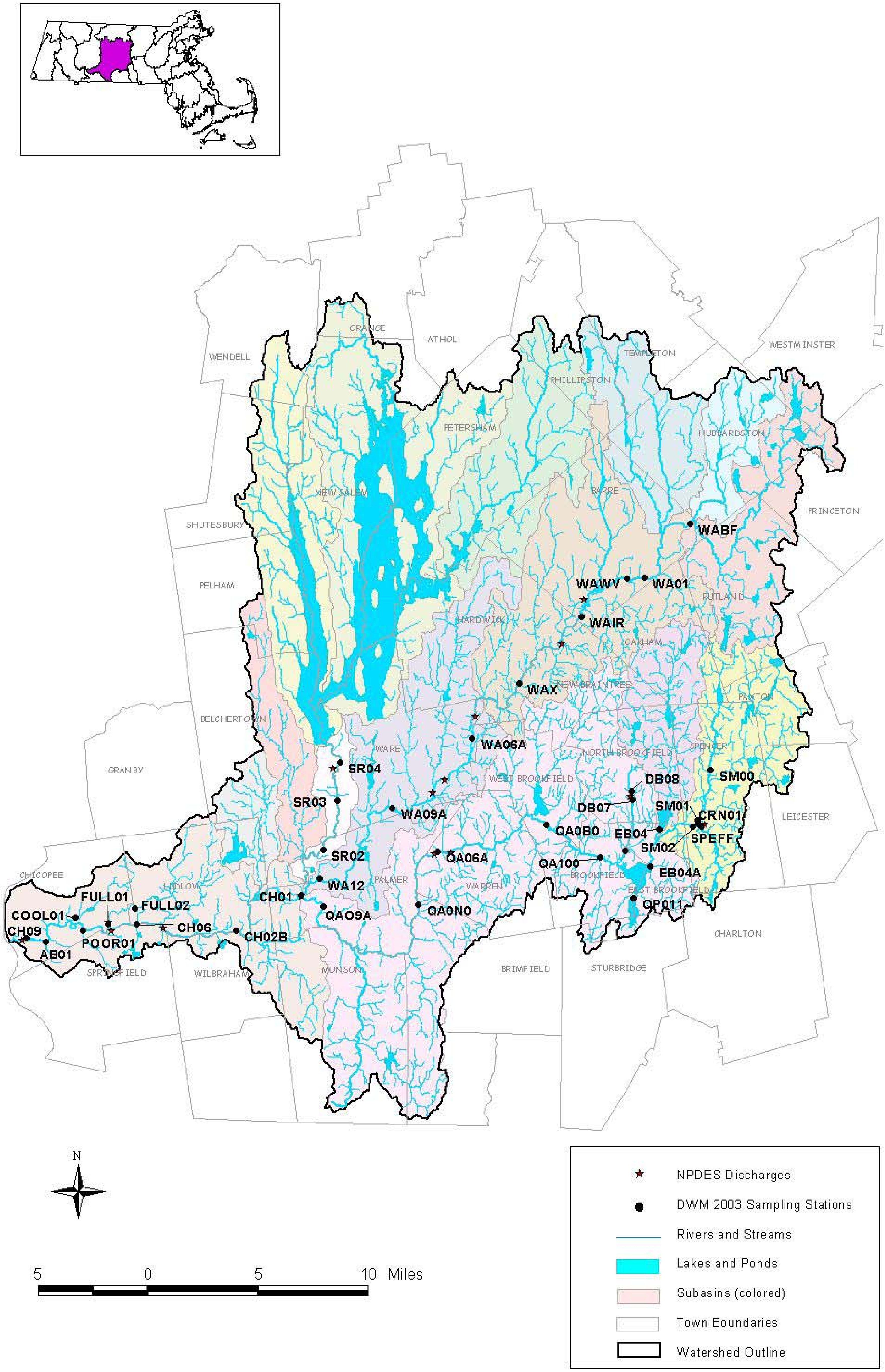

Figure C2. Chicopee River Watershed 2003 Monitoring Locations

Connecticut Watershed (2003 QAPP, Elements 5-8)

Connecticut River, French King Bridge (November, 2002)

5.0 PROJECT DEFINITION AND BACKGROUND INFORMATION

5.1 Goals & Objectives and Intended Use of the Connecticut River Watershed Data

The goal of the Connecticut River Watershed Year 2 Survey is to obtain information at a total of 51 sampling locations that meets the following DWM programmatic objectives.

Objective 1: Evaluate specific water bodies for support of designated uses (using Section 305(b) of the CWA), determine if State water quality standards are being met, and evaluate the level of impairment of CWA Section 303(d)-listed waterbodies.

Objective 2: Provide quality-assured data for use by DWM in developing Total Maximum Daily Loads (TMDLs) for State 303(d) listed waterbodies.

Objective 3: Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides). ***(subject to revision)***

Objective 4: Provide quality-assured E. coli data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts freshwater criteria for E. coli.

5.2 Connecticut River Watershed Map

The Connecticut River Watershed is shown in **Figure CT1** provided at the end of Element 8 (Connecticut).

5.3 Recent Historical Data

In general, there is a significant lack of recent quality assured data for the Connecticut River Watershed. Currently, there are no volunteer watershed organizations producing quality assured data regarding either the mainstem Connecticut River or any of the watersheds tributaries.

The Division of Watershed Management produced a report entitled "Connecticut River Basin 1998 Water Quality Assessment Report" (MADEP 2000). "This report presents a summary of current water quality data/information as it relates to assessing the status of the State's designated uses for 27 rivers in the Connecticut River Basin." (MADEP 2000). While this report used and evaluated data pertaining to 44% of the 583 river miles within the watershed, large data gaps in spatial coverage need to be addressed.

The Western Regional Office of the Massachusetts Department of Environmental Protection (with the assistance of the consulting firm Metcalf and Eddy) conducted a study of the inputs of fecal coliform bacteria to the Connecticut River from the Oxbow (Easthampton) downstream to the Connecticut border. The report ("River and Storm Drain Sampling in the Connecticut River for Water Quality Assessment" (MADEP 2000)) generated from this study found high levels of coliform bacteria from CSOs (Combined Sewage Outfalls) to the lower Connecticut River.

Smith College has been using the Mill River (Northampton) as a sub-watershed in which to conduct educational investigations regarding surface water quality. Of special note is the documentation of colonies of endangered Dwarf Wedge mussels (*Alasmidonta heterodon*) by a University of Massachusetts student. Although data collected during Smith College's studies cannot be cited directly due to lack of quality assurance, the research is quite helpful in describing the overall healh of this sub-watershed.

The Massachusetts Water Watch Partnership (MassWWP), and its volunteers conducted a coliform study of primary contact recreation areas ("Connecticut River Swimming Hole Project", MassWWP 1998) on the mainstem Connecticut River. This report notes the variation of coliform levels found within the river. Although some sample holding times were exceeded and this data has not been validated by DWM, the report documents excessive coliform concentrations at several locations.

The Department of Fisheries and Wildlife Environmental Law Enforcement (DFWELE) conducts on going investigations on the status of fish populations in the tributaries of the Connecticut River. This data may be used to assess the Aquatic Life Use potential in sampled tributaries. Data from their examinations may also be used to define segments as either "warm" or "cold" water fisheries.

Marin Environmental Consultants performed an in-stream flow examination of Roaring Brook (Conway / Whately). This stream is impounded by the Town of South Deerfield for the purposes of drinking water supply. The study notes that a large portion of this stream water is being withdrawn.

The Natural Resource Conservation Service (NRCS-USDA) has performed a habitat assessment at 14 sites along the Sawmill River (Leverett / Montague). The report documents areas of stream bank erosion, non-native invasive plant species, and instream habitat sedimentation.

See also **Table CT2** for summary of recent historical data.

5.4 Data Gaps

The assessment of surface waters within the Connecticut River Watershed remains incomplete. The spatial coverage omits many waterbodies. Most of these omitted waters are small perennial streams, and small (< four-hectares) ponds. Although it is the ultimate goal of DWM to assess all the waters of the Commonwealth, it is logistically and economically impractical to attempt to assess all waterbodies in the Connecticut Watershed in a single year. The logistics and economics of water quality monitoring also affect the temporal coverage within the watershed. At present, the DWM is assessing water quality conditions during the primary contact recreation season (1-April to 15-October). While water conditions during this time period usually represent the "worst case" conditions.

Data needs for the Connecticut River Watershed include total phosphorous, ammonia-nitrogen, solids, fish tissue contaminants, fish populations, benthic communities, habitat assessment, fecal coliform bacteria and *E-coli.* bacteria (especially in light of the pending freshwater water quality standard for *E. coli*. bacteria).

Both industrial and municipal point sources discharge to the Connecticut River and its tributaries. Many of these have recently been re-permitted under the National Pollution Discharge Elimination System (NPDES). Establishing ambient monitoring stations upstream and downstream of these discharges for selected analytes such as those listed above can determine if these sources are within their new compliance parameters.

Seven river segments in the Connecticut Watershed are currently listed on the proposed 2002 Massachusetts CWA Integrated List of Waters, Category Five Waters. Monitoring of these segments during Year 2 monitoring can determine if these listings are valid. A large part of DWM's activities will be spent on coordinating the efforts and data from federal, state, county, municipal, and volunteer organizations. Compilation and assessment of this data can result in a more inclusive assessment of the stressors in this watershed.

5.5 Massachusetts 2002 Integrated List of Waters (draft):

The seven river segments and 19 lake segments currently on the proposed 2002 CWA Massachusetts Integrated List of Waters, Category Five Waters are as follows:

Table CT1. CWA Integrated List of Waters, Category Five (draft, 2002)

Waterbody	Segment ID	Parameter(s) and Codes
Connecticut River	MA34-01	Pathogens, Priority Organics, Flow Alteration, Habitat Alteration, Pathogens
Connecticut River	MA34-02	Priority Organics, Flow Alteration, Habitat Alteration
Connecticut River	MA34-03	Priority Organics, Flow Alteration, Suspended Solids
Connecticut River	MA34-04	Priority Organics, Pathogens
Connecticut River	MA34-05	Priority Organics, Pathogens, Suspended Solids
Lampson Brook	MA34-06	Unionized Ammonia, Chlorine, Nutrients, Organic Enrichment
Weston Brook	MA34-23	Unionized Ammonia, Chlorine, Nutrients, Organic Enrichment
Arcadia Lake	MA34005	Nutrients, Noxious Aquatic Plants, Exotic species
Barton's Cove	MA34122	Priority Organics, Exotic Species
Forge Pond	MA34024	Nutrients, Noxious Aquatic Plants, Exotic Species
Leaping Well Res.	MA34040	Noxious Aquatic Plants
Log Pond Cove (McNulty Park)	MA34124	Priority Organics, Exotic Species
Lake Lookout	MA34044	Noxious Aquatic Plants, Turbidity
Lower Pond	MA34049	Noxious Aquatic Plants, Exotic Species
Metacomet Lake	MA34051	Organic Enrichment, Exotic Species
Mill Pond	MA34052	Taste, Odor, and Color, Noxious Aquatic Plants
Mountain Lake	MA34055	Noxious Aquatic Plants, Turbidity
Nashawannuck Pond	MA34057	Nutrients, Organic Enrichment, Noxious Aquatic Plants, Turbidity
Noonan Cove	MA34058	Noxious Aquatic Plants, Turbidity
Oxbow	MA34066	Turbidity
Porter Lake	MA34073	Noxious Aquatic Plants, Exotic Species
Porter Lake West	MA34072	Noxious Aquatic Plants, Exotic Species
Rubber Thread Pond	MA34105	Noxious Aquatic Plants
Upper Van Horn Park Pond	MA34128	Nutrients, Noxious Aquatic Plants, Turbidity
Venture Pond	MA34096	Nutrients, Organic Enrichment, Noxious Aquatic Plants, Turbidity
Watershops Pond	MA34099	Noxious Aquatic Plants, Turbidity

5.6 Planned 2003-2004 Non-DWM Monitoring

The Massachusetts Division of Fisheries and Wildlife Environmental Law Enforcement (DFWELE) is currently planning to conduct fish population surveys at numerous locations within the Connecticut Watershed in 2003 - 2004. This data will be of great assistance in assessing the type of fishery (cold water vs. warm water) each sampled segment is capable of supporting. Currently, the 2003 DFWELE sampling stations are still to be determined. DWM will remain in contact with DFWELE to assist, coordinate, and avoid duplication of efforts.

The United States Geological Survey (USGS) will be conducting a human vs. animal source tracing study of coliform bacteria using repetitive polymerase chain reaction (rep-PCR) techniques in the Connecticut River during the summer of 2003. This study will document both the concentrations of coliform within the watershed, as well as the species of animal from which the coliform bacteria originated. At present, no stations have been chosen for this examination. DWM will remain in contact with the USGS to assist, coordinate, and avoid duplication of efforts.

The City of Springfield will be conducting a fish tissue contamination study within the City to determine any potential health risks to citizens ingesting captured fish. DWM will also remain in contact with the City of Springfield to assist, coordinate, and avoid duplication of efforts.

Table CT2. Summary of Recent Historical Data for the Connecticut River Watershed

Data Source (Originating Organization, Report Title and Date)	Data Collection Type, Locations and Dates	How Data Will Be Used	Limitations on Data Use
Smith College, On going research project in conjunction with Umass/Amherst. 1997-present	1997 – Present. Ambient water quality, instream habitat assessments, fisheries assessments, and macroinvertebrate assessments	Comparative purposes; sampling design development	The Smith College project did not and does not have an approved QAPP. Data may be of limited use.
Massachusetts Water Watch Partnership, "Connecticut River Swimming Hole Project" 1998.	Volunteer collected fecal coliform samples from primary contact recreational areas. 1998.	Comparative purposes; sampling design development	This study occasionally violated holding time limits for fecal coliform analysis. Data may be used for descriptive purposes only.
DFWELE, continuous reporting 1997-Present	Fish Population Data. Continuous.	Comparative purposes; sampling design development; waterbody assessment	None. DFWELE has developed working SOPs for the collection of fish and documenting results.
Marin Environmental, "South Deerfield Water District Estimation of the Natural Base Flow for the Roaring Brook Watershed Conway, Whately and Deerfield, Massachusetts" 2001	Flow Study. 2001.	Comparative purposes; sampling design development; waterbody assessment	None
Natural Resources Conservation Service, "Sawmill River Watershed Assessment" 2002.	Instream and Riparian Habitat Assessment. 2002.	Comparative purposes; sampling design development	No QAPP was produced in conjunction with this study. Data may be of limited use.
Metcalf and Eddy, "River and Storm Drain Sampling Connecticut River Water Quality Assessment" 2001	Coliform Bacteria Study. 2001.	Comparative purposes; sampling design development; waterbody assessment	None

6.0 PROJECT OVERVIEW AND SCHEDULE

6.1 Overview of 2003 Connecticut River Watershed Monitoring

6.1.1 <u>River/Stream Monitoring</u>:

Provided existing DWM staffing (as well as some seasonal workers), water quality monitoring will be conducted at 32 locations in the Connecticut River Watershed. The proposed 2003 DWM assessment will attempt to address conditions at 18 of the 32 existing waterbody segments, and 9 previously-unassessed streams. (The 1998 Connecticut River Basin Water Quality Assessment Report (MADEP 2000) assessed 6 of 32 designated river segments).

No stormwater, or wet-weather-type sampling is proposed. Although dissolved oxygen (DO) is not considered to be a major problem in the Connecticut River Watershed, most DO measurements will be scheduled for pre-dawn surveys to document "worst case" conditions. Also, no site-specific streamflow measurements are planned. However, data from the 3 active USGS gages within the watershed shall be employed. Those three gages are:

01170500 Connecticut River at Montague City, MA
01171500 Mill River at Northampton, MA
01172003 Connecticut River below power dam at Holyoke, MA.

Grab water samples for bacteria, TSS and turbidity will be delivered to Severn Trent Laboratories in Westfield for analysis (tentative). All other samples will be delivered to the Senator William Wall Experiment Station in Lawrence, MA for analysis.

6.1.2 <u>Lake/Pond Monitoring</u>:

Lakes monitoring for TMDL development and watershed assessment will be conducted at 6 locations--- Arcadia Lake, Metacomet Lake, Forge Pond, Porter Lake, Porter Lake West, and the Oxbow.

Water quality sampling will be conducted 3 times over the summer. Water quality measurements will include temperature, pH, dissolved oxygen/% saturation, specific conductance, apparent color, Secchi depth, chlorophyll a, and total phosphorus. Aquatic macrophyte mapping will also be performed on one occasion in each lake. Bathymetric depth mapping will also be performed as resources allow.

6.1.3 <u>Benthic Macroinvertebrate and Aquatic Habitat Monitoring</u>: ***(subject to revision)***

Benthic macroinvertebrates and periphyton may be sampled, and respective habitats assessed at up to 24 stations on one occasion, using DWM modified Rapid Bioassessment Protocols (RBPs) III. Benthic macroinvertebrates functional feeding group, community composition, pollution tolerance, and abundance metrics are calculated to determine aquatic life use status.

6.1.4 <u>Fish Toxics Monitoring</u>: ***(subject to revision)***

Fish tissue contaminant monitoring may be conducted at Metacomet Lake, Oxbow, and Lake Pleasant. Fish are collected from each waterbody on one occasion. Three fish composites of edible fillets from 1-3 feeding group types are analyzed for selected metals, PCBs, and organochlorine pesticides.

6.1.5 <u>Fish Population Monitoring</u>: ***(subject to revision)***

Fish assemblages may be sampled on one occasion at 6 sites in the Connecticut River Watershed using approved DWM SOPs. The Massachusetts Dept. of Fish and Wildlife Environmental Law Enforcement (DFWELE) will be performing numerous population surveys in the Connecticut Watershed in 2003. DWM has coordinated with DFWELE to minimize duplication of effort.

6.2 Monitoring Schedules: See **Table CT3**.

TABLE CT3. Project Schedules for 2003 Connecticut River Watershed Monitoring

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
***River/Stream Surveys*:**				
Coordination, meetings, reconnaissance, river/stream sampling plan development, etc.	November, 2002	February, 2003	Draft sampling plan; meeting notes, etc.	February, 2003
Draft sampling plan review and approval	January, 2003	February, 2003	Internal DWM concurrence on sampling plan	February, 2003
2003 DWM monitoring QAPP	February, 2003	March, 2003	2003 DWM Monitoring QAPP	March, 2003
Water quality sampling surveys (5 rounds)	May, 2003	September, 2003	Field data; lab samples to WES	May-September, 2003
Data QA/QC review and validation	January, 2004	March, 2004	2003 Data Validation Report	March, 2004
Connecticut River Watershed Assessment Report	2004	2005	Connecticut River Watershed Assessment Report	2005
***Lake Surveys*:**				
2003 Lakes Baseline TMDL QAPP development, review and approval	November, 2002	March, 2003	2003 Lakes Baseline TMDL QAPP	March, 2003
Lakes sampling surveys (3 rounds)	June, 2003	September, 2003	Field data; lab samples	June-September, 2003
Aquatic plant surveys	June, 2003	September, 2003	Field data; plant maps	October, 2003
Preliminary survey report	December, 2003	January, 2004	Technical memorandum	January, 2004
Connecticut River Watershed Assessment Report	2004	2005	Connecticut River Watershed Assessment Report	2005
Draft TMDL Reports for Connecticut waterbodies	January 2005	December 2005	Draft TMDL Reports	December, 2005
Benthic Macroinvertebrate/Aquatic Habitat Surveys: (subject to revision)				
2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP development, review and approval	November, 2002	April, 2003	2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP	April, 2003
Benthic/Habitat sampling surveys (1 round)	June, 2003	September, 2003	Field data; benthic samples to DWM	September, 2003
Macroinvertebrate/Habitat Assessment Technical Memorandum	October, 2003	2004	Macroinvertebrate/Habitat Assessment Technical Memorandum	2004
Connecticut RiverWatershed Assessment Report	2004	2005	Connecticut River Watershed Assessment Report	2005

Activity	Approx. Date of Initiation	Approx. Date of Completion	Deliverable	Deliverable Due Date
Fish Population Surveys*: *(subject to revision)				
Fish Population sampling surveys (1 round)	July/September, 2003	July/September, 2003	Field data	September, 2003
Fish Population data review, analysis and preliminary reporting	September, 2003	2004	Fish Population Technical Memorandum	2004
Connecticut River Watershed Assessment Report	2004	2005	Connecticut River Watershed Assessment Report	2005
Fish Toxics Surveys*: *(subject to revision)				
2003 Fish Toxics sampling plan development, review and approval	January, 2003	March, 2003	2003 Fish Toxics QAPP (modified 2002 QAPP for new sites)	March, 2003
Fish Toxics sampling surveys (1 round)	June/July, 2003	June/July, 2003	Field data; lab samples	July, 2003
Fish Toxics data review and preliminary report	September, 2003	2004	Fish Toxics Technical Memorandum	2004
Connecticut River Watershed Assessment Report	2004	2005	Connecticut River Watershed Assessment Report	2005

7.0 DATA QUALITY OBJECTIVES and PERFORMANCE CRITERIA

Monitoring data for the Connecticut River watershed will meet the specific data quality objectives (DQOs) outlined in Element 13. Not meeting these planned DQOs may subject project data to qualification or censoring during post-monitoring quality control review (see Elements 16-19 for discussion of data assessment and validation).

8.0 SAMPLING DESIGN

8.1 Design Rationale for 2003 Connecticut Watershed Monitoring

8.1.1 River/Stream Monitoring:

Water quality monitoring will be conducted at 32 stations in the Connecticut River Watershed. Sampling will be conducted on five occasions during the primary contact season of 1-April through 15 October. All bacteria, TSS and turbidity samples will be delivered to Severn Trent Labs (tentative) for analysis.

Samples collections will be performed by three (3) crews on each survey as follows:

Mainstem Survey Crew:
Sampling the mainstem of the Connecticut River introduces several challenges related to representativeness and variability with width and depth. Due to laminar-like flow in most portions of the mainstem, influent flows entering the river near banks may not mix thoroughly with the main flow for many miles. In order to obtain representative samples (and because the river is too wide and deep for wading, and the majority of available bridges are too high above the river to safely and properly sample using DWM's basket sampler), one (1) mainstem survey crew will collect samples on the mainstem Connecticut River from a boat.

Rather than taking one grab sample per station along the thalweg, transects will be established at all mainstem stations for the taking of composite samples (five equal-width-increment sub-samples) for Nutrients (NH_3-N, TP at all stations), Solids (TSS and turbidity at selected locations) and Chemistry (alkalinity and hardness at selected locations). The sub-samples will be composited into a single sample, representing average water quality conditions across the river. Mainstem Chlorophyll a samples will be collected as a single (discrete) sample from the mid-point of the river. Bacterial samples (fecal coliform and E. coli) will be collected at three locations along each designated transect and be analyzed as discrete samples to evaluate spatial variability laterally across the river. Bacteria, TSS and turbidity samples will be delivered to Severn Trent Labs (tentative) for analysis. Chemistry samples will be collected at the upper, mid, and lower mainstem only. One (per station) mid-river multi-probe parameter depth profiles will also be taken. Mid-day dissolved oxygen measurements will be conducted once (in late July or early August) in the mainstem and some of the lower gradient (slow moving) tributaries. This will be done to assess the daytime flux in dissolved oxygen.

Non-Mainstem Survey Crews:
Two (2) survey crews will collect major and minor tributary water samples using grab sampling techniques via wade-in and bridge-drop techniques as described and approved in DWMs SOPs. One crew will collect coliform bacteria samples only for direct transport to the Severn Trent Lab (tentative) within 6 hours. All samples shall be transported on ice and in the dark to the appropriate laboratories for analysis. At each station, water quality measurements will be obtained in the field using a multi-probe instrument (pH, Temperature, Conductivity, Dissolved Oxygen).

See **Table CT4** for river/stream sample station IDs, descriptions, parameters and frequencies, and **Figure CT1** for sample site locations.

Station-Specific Rationales:
<u>Mainstem Stations</u>:

► Waterbody Name: **Connecticut River**
Segment Number: **34-01**
Station Number: **01A**
Station Name: Pauchaug Meadow Boat Launch
Latitude / Longitude: 42.42.53 / 72.27.12
USGS Quad Map: Northfield
Assessment parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
<u>Objective(s) Met:</u> **<u>Objective 1 and 4</u>**
Station 01A is located near the Pauchaug Meadow Boat Launch in Northfield, MA, and is the most upstream mainstem location on the Connecticut River (0.85 river miles below the VT/NH border). This segment is currently listed as a Category Five Water due to Priority Organics (PCBs in fish tissues), Flow Alteration (Vernon Dam, VT, Northfield Mountain Pumped Storage, MA and Turners Falls Dam, MA), Habitat Alterations (river bank erosion), and Pathogens. This segment was not sampled by DWM during the 1998 assessment. Assessments of Aquatic Life and Fish Consumption were made through data from outside agencies. <u>This station will be used to assess water quality conditions at the Vermont/Massachusetts border</u>. As such, all Connecticut River Watershed monitoring parameters will be sampled for, in order to compare conditions at this station to other downstream stations. Water volume entering the state shall be calculated by adding reports from USGen (United States Generating Systems) at the Vernon Dam, VT and data from the USGS gage on the Ashuelot River. *(Because the mainstem of the Connecticut River is too deep and wide to sample macroinvertebrates using standard (wadeable stream) methodologies, a collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

► Waterbody Name: **Connecticut River**
Segment Number: **34-02**
Station Number: **02A**
Station Name: Riverview Picnic Area
Latitude / Longitude: 42.36.45 / 72.28.46
USGS Quad Map: Miller's Falls
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
<u>Objective(s) Met:</u> **<u>Objective 1 and 4</u>**
Station 02A is located 8.25 river miles downstream from the Pauchaug Meadow Boat Launch, and drains an additional 46 square miles of watershed area. This segment was not sampled by DWM during the 1998 assessment. Assessments of Aquatic Life and Fish Consumption were made through data from outside agencies. Potential impacts to water quality in this area include drainage from the Town of Northfield and Northfield-Mount Hermon Preparatory Academy, riparian agricultural activities, and flow modification. This segment (34-02) is a Category Five Water due to Priority Organics (PCBs in fish tissues), Flow Alteration, and Habitat Modification. The shoreline erosion within this sampling reach has been remediated through the application of individual projects that focused on small segments of the riverbank. There are still agricultural areas upstream of this reach that have a diminishing (or non-existent) riparian buffer. (*Because the mainstem of the Connecticut River is too deep and wide to sample macroinvertebrates using standard (wadeable stream) methodologies, a collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

► Waterbody Name: **Connecticut River**
Segment Number: **34-04**
Station Number: **04A**
Station Name: Sunderland Bridge
Latitude / Longitude: 42.28.03 / 72.34.59
USGS Quad Map: Mt. Toby
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
<u>Objective(s) Met:</u> **<u>Objectives 1 and 4</u>**
This segment (34-04) runs from the confluence of the Connecticut River and the Deerfield River to the Holyoke Dam (34.2 miles). This segment was not sampled by DWM during the 1998 assessment. Assessments of Aquatic Life and Fish Consumption were made through data from outside agencies. Station 04A is located 9.3 river miles downstream of the

confluence with the Deerfield River, and it is assumed that the Deerfield and the Connecticut River are fully mixed at this location. This station is below the inputs from the City of Greenfield, the Bitzer State Fish Hatchery, the Turner's Falls Dam, and the industrialized power canal at Turner's Falls. The boat launch at the base of the Sunderland bridge is the most upstream boat-launch available to access this segment. *(Because the mainstem of the Connecticut River is too deep and wide to sample macroinvertebrates using standard (wadeable stream) methodologies, a collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

►Waterbody Name: **Connecticut River** **(DELETE)**
Segment Number: **34-04**
Station Number: **04B**
Station Name: Hatfield Boat Launch
Latitude / Longitude: 42.23.36 / 72.35.22
USGS Quad Map: Mt. Toby
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
Objective(s) Met: **Objective 1 and 4**
Station 04B is located at about the mid-point in this segment (16 miles downstream of Deerfield River Confluence and upstream of the confluence with Mill River (Hadley)). There are no major tributaries entering the river between this station and the Sunderland Bridge station. Potential pollution sources include the South Deerfield WWTP, the Amherst WWTP, agriculture, and the two fish hatcheries (Red Wing Meadow Farm, Sunderland State Fish Hatchery). Caution must be taken when sampling at this location as the Hatfield WWTP is located just upstream of the boat launch. Sampling using a boat will enable samples to be taken upstream of the Hatfield WWTP outfall. *(Because the mainstem of the Connecticut River is too deep and wide to sample macroinvertebrates using standard (wadeable stream) methodologies, a collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

►Waterbody Name: **Connecticut River**
Segment Number: **34-04**
Station Number: **04C**
Station Name: Oxbow Marina
Latitude / Longitude: 42.17.15 / 72.36.53
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
Objective(s) Met: **Objective 1 and 4**
Station 04C is located opposite from the Oxbow formed at the confluence of the Manhan and Connecticut Rivers. This station is 12 river miles downstream of the Hatfield Boat Launch (5 river miles downstream of the Coolidge Bridge). Samples must be taken by boat in order access the mainstem Connecticut River. Samples will be taken downstream of the Oxbow. A transect will be established from Russell Cove to the western shore to guide the sampling. (*A collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

►Waterbody Name: **Connecticut River** **(DELETE)**
Segment Number: **34-04**
Station Number: **04D**
Station Name: Brunnelle's Marina
Latitude / Longitude: 42.16.26 / 72.35.57
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
Objective(s) Met: **Objective 1 and 4**
Station 04D is 2.14 river miles downstream of the Oxbow, at the confluence with Stony Brook. Samples will be taken by boat, upstream of both Stony Brook and Bachelor Brook. This will allow assessment of the potential effects of the Electrical Generating Plant. *(A collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

►Waterbody Name: **Connecticut River**

Segment Number: **34-05**
Station Number: **05A**
Station Name: Route 90 Boat Launch
Latitude / Longitude: 42.09.12 / 72.37.32
USGS Quad Map: Mt. Tom
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
Objective(s) Met: **Objective 1 and 4**
Station 05A is located below the Holyoke Power Dam. This segment was not sampled by DWM during the 1998 assessment. Assessments of Fish Consumption, Primary and Secondary Contact Recreation were made through data from outside agencies. This station is located in the most heavily urbanized portion of the watershed. Data from the USGS Thompsonville gage will provide external data for the Connecticut River as it leaves the State. This segment is on the Integrated List of Waters, Category Five for Priority Organics, Pathogens, and Suspended Solids. *(A collection of exuvia at this location may be taken in order to assess the Aquatic Life Use status at this location).*

►Waterbody Name: **Connecticut River** ***(subject to revision; may be Multi-probe only)***
Segment Number: **34-05**
Station Number: **05B**
Station Name: CT Border
Latitude / Longitude: 42.01.52 / 72.36.28
USGS Quad Map: Springfield South
Assessment Parameters: Multi-probe (dissolved oxygen, temperature, pH, conductivity), Nutrients (TP, NH3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Chlorophyll-a, TSS
Objective(s) Met: **Objective 1 and 4**
Station 05B is located at the State-line as it crosses the Connecticut border at the town of Agawam. This is the most downstream mainstem station on the Connecticut River. Data from this station may be compared to data collected at upstream mainstem stations, and represents water quality conditions as the Connecticut River leaves the state of Massachusetts and enters Connecticut. *(A collection of exuvia at this location may be taken to assess the Aquatic Life Use status at this location).*

Major Tributary Stations:

Major tributaries (Miller's River, Deerfield River, Chicopee River and the Westfield River) are all identified as individual watersheds, and, as such, are sampled by DWM during the five-year basin cycle. There are concerns regarding comparative nutrient loading between these major inputs. For Connecticut River monitoring, the following major tributaries shall be sampled for nutrients at one location at the respective mouths prior to entering the Connecticut River:

►Waterbody Name: **Miller's River** ***(subject to revision/deletion)***
Segment Number: **35-05**
Station Number: **CT05**
Station Name: Miller's River at Route 63 Bridge
Latitude / Longitude: 42.34.50 / 72.29.43
USGS Quad Map: Orange
Assessment Parameters: Nutrients (TP and NH3-N)
Objective(s) Met: **Objective 1, 2 and 4**
This river enters the Connecticut River in the City of Montague. The river averages an annual flow of 640 cfs into the Connecticut River. Determining the magnitude of nutrient concentrations for the Miller's River entering the Connecticut River on five separate occasions will allow a comparative evaluation of all major tributary nutrient loading to the Connecticut River in Massachusetts.

►Waterbody Name: **Deerfield River** ***(subject to revision/deletion)***
Segment Number: **33-04**
Station Number: **CT04**
Station Name: Deerfield River at Route 5/10 Bridge
Latitude / Longitude: 42.34.10 / 72. 35.32
USGS Quad Map: Greenfield
Assessment Parameters: Nutrients (TP and NH3-N)

Objective(s) Met: **Objective 1, 2 and 4**
This river enters the Connecticut River in the City of Greenfield. The river averages an annual flow of 1318cfs into the Connecticut River. Determining the magnitude of nutrient concentrations for the Deerfield River entering the Connecticut River on five separate occasions will allow a comparative evaluation of all major tributary nutrient loading to the Connecticut River in Massachusetts.

►Waterbody Name: **Chicopee River** ***(subject to revision/deletion)***
Segment Number: **36-25**
Station Number: **CT03**
Latitude / Longitude: 42.09.00 / 72.36.27
USGS Quad Map: Springfield North
Assessment Parameters: Nutrients (TP and NH3-N)
Objective(s) Met: **Objective 1, 2 and 4**
This river enters the Connecticut River in the City of Chicopee. The river averages an annual flow of 912cfs into the Connecticut River. Determining the magnitude of nutrient concentrations for the Chicopee River entering the Connecticut River on five separate occasions will allow a comparative evaluation of all major tributary nutrient loading to the Connecticut River in Massachusetts.

►Waterbody Name: **Westfield River** ***(subject to revision/deletion)***
Segment Number: **32-07**
Station Number: **CT02**
Station Name: Westfield River at Route 147 Bridge
Latitude / Longitude: 42.05.24 / 72.37.36
USGS Quad Map: West Springfield
Assessment Parameters: Nutrients (TP and NH3-N)
Objective(s) Met: **Objective 1, 2 and 4**
This river enters the Connecticut River in the City of West Springfield. The river averages an annual flow of 936cfs into the Connecticut River. Determining the magnitude of nutrient concentrations for the Westfield River entering the Connecticut River on five separate occasions will allow a comparative evaluation of all major tributary nutrient loading to the Connecticut River in Massachusetts.

Minor Tributaries:

The following smaller tributaries to the Connecticut River are lower order streams and rivers draining to the Connecticut River Watershed. These tributaries may have significant impacts on the water quality of the Connecticut River.

►Waterbody Name: **Falls River**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **FR01**
Station Name: Falls River at Bascom Road
Latitude / Longitude: 42.38.40 / 72.32.34
USGS Quad Map: Bernardston
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates, Aquatic Habitat Assessment, Fish Populations
Objective(s) Met: **Objective 1 and 4**
This river is not currently a defined segment. It drains 30.5 mi^2 of watershed in MA before discharging into the Connecticut River (segment 34-01). It has never been assessed by DWM. Sampling the river at this location will investigate possible impacts from agricultural runoff/erosion and road runoff from Route 91 and Route 5.

►Waterbody Name: **Sawmill River**
Segment Number: **34-26**
Station Number: **26A**
Station Name: Sawmill River at South Ferry Road
Latitude / Longitude: 42.32.33 / 72.32.56
USGS Quad Map: Greenfield

Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates, Aquatic Habitat Assessment, Fish Populations
Objective(s) Met: **Objective 1 and 4**
This river drains 31mi^2, from its origin at the outfall of Lake Wyola to its confluence with the Connecticut River. It is proposed to be designated a Massachusetts 2002 Integrated List of Waters, Category Three water with no uses assessed. At this location, the river receives run-off from the town of Montague, as well as agricultural inputs.

►Waterbody Name: **Mill River (Hadley)**
Segment Number: **34-25**
Station Number: **25A**
Station Name: Mill River Recreation Area
Latitude / Longitude: 42.24.41 / 72.31.41
USGS Quad Map: Mt. Toby
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates
Objective(s) Met: **Objective 1 and 4**
This river is proposed to be designated a Massachusetts 2002 Integrated List of Waters, Category Three water, with no uses assessed. The watershed for the upper most portion of this stream is protected as a drinking water supply for the town of Amherst. The stream then flows through a heavily used pond (Factory Hollow Pond). Then it flows through the Mill River recreation area. Establishing a station at the Mill River Recreation Area (and two stations further downstream) will allow us to assess the potential impacts from the town of Amherst, and Umass/Amherst, to this stream.

►Waterbody Name: **Mill River (Hadley)**
Segment Number**: 34-25**
Station Number: **25C**
Station Name: Mill Site Road
Latitude / Longitude: 42.23.10 / 72.33.00
USGS Quad Map: Mt. Toby
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), Alkalinity, Hardness, fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
The drainage area upstream of this location is 26.8 mi^2. The river begins its path to the Connecticut River as a drinking water supply for the Town of Amherst. It then flows into Factory Hollow Pond (aka Puffer's Pond). This pond receives extensive recreational use. The stream emerges from this pond via an overflow dam. It receives the run-off from residential and commercial land use in North Amherst. The stream crosses Route 116 and joins Eastman Brook (which receives the discharge from Bioshelters Fish Hatchery and the Cronin National Fish Hatchery). The stream then turns south and parallels Rte. 116. Here, it receives run-off from several farms. This stream is a proposed Category Three water, with no uses assessed.

►Waterbody Name: **Fort River**
Segment Number: **34-27**
Station Number: **27B**
Station Name: Fort River at Route 47
Latitude / Longitude: 42.19.58 / 72.34.43
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates
Objective(s) Met: **Objective 1 and 4**
This river is a proposed Category Three water, with no uses assessed. Approximately 56.4 mi^2 of drainage area lie upstream of this location. The majority of the river is low-gradient with a relatively sandy substrate. Much of the water in the river comes from Larence Swamp (a high-density area of ground water supply). The river meanders heavily on it's way to the Connecticut River. At this proposed location, the river has received suburban run-off from the town of Amherst and the Mill Valley Golf Course, and agricultural run-off from several farms.

►Waterbody Name: **Bachelor Brook**
Segment Number**: 34-07**

Station Number: **07A**
Station Name: Bachelor Brook at Route 47
Latitude / Longitude: 42.16.12 / 72.35.12
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
Bachelor Brook runs along the southern foot of the Holyoke Range, from the outlet of Forge Pond, Granby to the Connecticut River, South Hadley. This is a proposed Category Three water, with no uses assessed, and with a 31 mi^2 drainage area to this location. Many small farms, wetlands, and residences exist within this area. Assessment of this segment will document the potential effects of non-point source (NPS) pollution from farms and residential development.

►Waterbody Name: **Stony Brook**
Segment Number**: 34-19**
Station Number: **19A**
Station Name: Stony Brook at Route 116
Latitude / Longitude: 42.14.47 / 72.34.49
USGS Quad Map: Springfield North
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates, Fish Population
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Three water, with no uses assessed, and with a 19.6mi^2 drainage area at this location. It flows through residential and agricultural landuses, and then through the town of South Hadley. The proximity of the stream to Route 116 allows for little riparian buffering, or canopy cover, opening this stream to potential NPS impacts.

►Waterbody Name: **Weston Brook**
Segment Number**: 34-23**
Station Number: **23A**
Station Name: Weston Brook at Boardman Street
Latitude / Longitude: 42.16.15 / 72.26.59
USGS Quad Map: Belchertown
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Benthic Macroinvertebrates, Fish Population
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Five water, with a 3.7 mi^2 drainage area upstream of this location. It has received, in the past, un-ionized ammonia from the Belchertown WWTP (upstream of this station). DWM performed no assessments of this water as part of the "Connecticut River Basin 1998 Water Quality Assessment Report" (MADEP 2000). The town of Belchertown has upgraded their WWTP within the past five years. It is now important to return to this segment and assess the current conditions of this stream.

►Waterbody Name: **Lampson Brook**
Segment Number**: 34-06**
Station Number: **06A**
Station Name: Lampson brook at George Hannum Street
Latitude / Longitude: 42.16.54 / 72.25.39
USGS Quad Map: Belchertown
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, TSS, Benthic Macroinvertebrates, Fish Population
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Five water, with a 1.8 mi^2 drainage area upstream of this location. This stream is a tributary to Weston Brook. The station is located immediately below the Belchertown STP. The STP has recently been retro-fitted to deal with un-ionized ammonia problems. DWM performed no recent assessments of this water. This station will assess the current conditions at this location.

►Waterbody Name: **Pecousic Brook** **(DELETE)**
Segment Number**: 34-XX (NO SEGMENT NUMBER ASSIGNED)**

Station Number: **PB01**
Station Name: Pecousic Brook at Dwight Street
Latitude / Longitude: 42.03.56 / 72.32.21
USGS Quad Map: Springfield South
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This stream is one of the most highly urbanized waters to be sampled in the Connecticut River Watershed in 2003. Although DFWELE, the Pecousic Brook stream team and other have performed recent monitoring here, it has never been assessed by DWM. The headwaters of this stream begin in the town of East Longmeadow. From there, they flow into the City of Springfield (Porter Lake in Forest Park) and eventually join the Connecticut River. Water quality concerns for this stream include NPS influences from East Longmeadow, Springfield, and Forest Park. This station, and station DB01 (see below) will assist in the TMDL development for Porter Lake, and Porter Lake West.

►Waterbody Name: **Dingle Brook** **(DELETE)**
Segment Number**: 34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **DB01**
Station Name: Dingle Brook at Tiffany Street
Latitude / Longitude: 42.04.30 / 72.32.52
USGS Quad Map: Springfield South
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
Dingle Brook is a small tributary to Porter Lake, may dry up in the summer months and has never been assessed by DWM. The stream's 1.1 mile length begins and ends in a heavily urbanized setting. Assessment of water quality conditions at this location is important to document perceived impacts from urban run-off. Collected data will also be used to further the TMDL assessments of Porter Lake (34073) and Porter Lake West (34072).

►Waterbody Name: **Scantic River**
Segment Number**: 34-30**
Station Number: **30A**
Station Name: Scantic River at South Road
Latitude / Longitude: 42.03.48 / 72.24.45
USGS Quad Map: Hampden
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Three water, with no uses assessed. At present, there is no WWTP servicing the town of Hampden, and all facilities must treat their discharges on-site. Recent increases in residential development in the area have raised concernbs regarding potential water quality impacts to the Scantic River.

►Waterbody Name: **East Branch Mill River (Northampton)**
Segment Number**: 34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **EBMR01**
Station Name: East branch Mill River at Mill Street
Latitude / Longitude: 42.23.31 / 72.43.35
USGS Quad Map: Williamsburg
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This river has never been assessed. The Mill River (Northampton) segment begins at the confluence of the East and West branches of the river (Williamsburg). The upstream drainage area, above station EBMR01, is 9.5 mi^2. Establishment of water quality stations such as this one upstream of the Mill River (Northampton) segment may help to more fully understand the effects of upstream land use changes to Mill River (Northampton) and to water quality in the East Branch Mill River.

►Waterbody Name: **West Branch Mill River (Northampton)**

Segment Number**: 34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **WBMR01**
Station Name: West Branch Mill River at Mill Street
Latitude / Longitude: 42.23.31 / 72.43.35
USGS Quad Map: Williamsburg
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This stream has never been assessed. This station will be sampled in concert with stations EBMR01 and 28B. Together, they will provide an assessment of the Mill River (Northampton) and its tributaries. The drainage area upstream of this location is approximately 12.75 mi^2.

►Waterbody Name: **Mill River (Northampton)**
Segment Number**: 34-28**
Station Number: **28B**
Station Name: Mill River at USGS Gage (Burts Pit Road)
Latitude / Longitude: 42.19.05 / 72.39.19
USGS Quad Map: Easthampton
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Three water, with no uses assessed. This station is located at the existing USGS gage near Smith College. The Mill River flows through historically industrial and currently dense residential landuse types before it reaches this station. Assessment of this segment (combined with that from EBMR01 and WBMR01) will provide us with a current description of potential water quality impacts from the City of Northampton. The drainage area upstream of this location (including both branches) measures 54 mi^2.

►Waterbody Name: **Mill River (Hatfield)**
Segment Number**: 34-24**
Station Number: **24B**
Station Name: Mill River at Elm Street
Latitude / Longitude: 42.21.59 / 72.36.17
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Fish Population
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Two water, with "Support" status determined for Aquatic Life and Aesthetics. This river has a drainage area of 48.4 mi^2 upstream of this station. It has been previously assessed as supporting Aquatic Life and Aesthetics (MADEP 2000). Aside from its high-gradient headwaters, the Mill River (Hatfield) takes a low-gradient, and meandering course through the farms of Hatfield. In addition to potential NPS agricultural run-off, there are inputs from Route 91, a fertilizer company (LESCO), water withdrawals by the towns of Northampton and South Deerfield, and industrial inputs from South Deerfield (Bloody Brook).

►Waterbody Name: **Bloody Brook**
Segment Number**: 34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **BB01**
Station Name: Bloody Brook at Whately Road
Latitude / Longitude: 42.28.42 / 72.37.06
USGS Quad Map: Mt. Holyoke
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Turbidity
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Three water, and has never been assessed. There are significant industrial discharges to this stream and concerns regarding the water quality in this stream still exist. Most recently, there have been concerns over excessive turbidity occurring in this tributary to Mill River (Hatfield). The source of the turbidity is still unknown.

►Waterbody Name: **Manhan River**
Segment Number**: 34-11**
Station Number: **11A**
Station Name: Manhan River at Glendale Street
Latitude / Longitude: 42.15.59 / 72.41.29
USGS Quad Map: Easthampton
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria, Fish Population
Objective(s) Met: **Objective 1 and 4**
This is a proposed Category Three water (ILW), with no uses assessed, and with a 58 mi^2 drainage area above this station. The Manhan River flows through and powers several mills in Easthampton. The impacts of both residential and industrial land use within the watershed will be assessed. This station (11A) is located upstream of the most urbanized portion of Easthampton. Two downstream locations (11B and 11C) will be used also to assess potential impacts to this waterbody.

►Waterbody Name: **Manhan River** **(DELETE)**
Segment Number**: 34-11**
Station Number: **11B**
Station Name: Manhan River at Lovefield Street
Latitude / Longitude: 42.16.47 / 72.39.13
USGS Quad Map: Easthampton
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This station is located immediately below the town of Easthampton, yet upstream of the inflow from Lower Mill Pond. The drainage area above this location measures 70 mi2. Between station 11A and this station (11B) the river flows along the northern edge of the urbanized area of Easthampton. It is assumed that the majority of potential impacts will be due to urban NPS run-off.

►Waterbody Name: **Manhan River**
Segment Number**: 34-11**
Station Number: **11C**
Station Name: Manhan River at Fort Hill Street
Latitude / Longitude: 42.17.00 / 72.38.25
USGS Quad Map: Easthampton
Assessment Parameters: Multi-probe (DO, temperature, pH, conductivity), Nutrients (TP, NH_3-N), fecal coliform bacteria, E. coli. bacteria
Objective(s) Met: **Objective 1 and 4**
This station is the furthest downstream station accessible on this river. This proposed Category Three water has a drainage area of 84 mi^2 upstream of this location. Between station 11B and this station (11C), the Manhan River receives the inflow from Lower Mill Pond. This pond, fed by Broad Brook, Rubber Thread Pond, and Nashawannuck Pond, receives the majority of industrial effluent. This station is also downstream of the Easthampton WWTP.

8.1.2 Lake/Pond Monitoring:

Consistent with DWM's general approach to watershed monitoring and TMDL development, Year-2 lakes monitoring in 2003 in the Connecticut Watershed will consist of three rounds, once a month in June, July and August, at the following locations:

1. Arcadia Lake (40 acres, PALIS 34005)
2. Metacomet Lake (70 acres, PALIS 34051)
3. Forge Pond (74 acres, PALIS 34024)
4. Porter Lake (28 acres, PALIS 34073)
5. Porter Lake West (5 acres, PALIS 34072), and
6. Oxbow (168 acres, PALIS 34066).

All 6 lakes are proposed "Category Five" waters, requiring a TMDL.. This monitoring will fulfill programmatic **Objective 2**.

Due to limitations on time and resources, samples will be taken at one, deep-hole station. In order to increase the number of lakes visited using limited staff, Multi-probe profiles for dissolved oxygen, temperature, conductivity, and pH will be performed only once in August-September (not for each round). Grab samples for TP and Chlorophyll a will be taken on each of the three rounds. See **Table CT4** for the list of ponds and inlets to be sampled, along with sample station IDs, descriptions, parameters and frequencies.

For more detailed information of 2003 lake sampling, see the 2003 Baseline Lakes TMDL QAPP (CN 128.0).

8.1.3 Benthic Macroinvertebrate and Aquatic Habitat Monitoring: ***(subject to revision)***

Up to sixteen (16) locations in the Connecticut Watershed may be sampled for benthic macroinvertebrates and aquatic habitat to investigate the effects of various point source and nonpoint source stressors—both historical and current—on resident aquatic communities. Some stream segments are currently "unassessed" by DWM. Other segments may be re-evaluated to determine if water quality and habitat conditions have improved or worsened over time (**Objective 1**). Seven (7) of these locations have been described in Element 8.1.1. Segment-specific rationales (and objectives met) for the nine (9) "benthic macroinvertebrate/aquatic habitat ONLY stations" in the Connecticut Watershed are provided below.

The main difficulties with monitoring benthic macroinvertebrates in the mainstem Connecticut River are the depth of the water and the lack of suitable substrate (e.g. the river exceeds depths of 100 feet in the vicinity of Barton Cove (Greenfield)). The primary substrate type in the mainstem is sand. Because of this, an alternative approach to assess the macroinvertebrate community may be to sample the exuvia (floating larval cases) along the banks of the river. For a more extensive description of the procedures for the collection of exuvia, see the 2003 Benthic Macroinvertebrate QAPP (CN 147.0).

See **Table CT4** for potential benthic/habitat sample station IDs, descriptions, parameters and frequencies, and **Figure CT1** for potential sample site locations. ***NOTE: All the following stations are subject to revision/deletion (as explained in Executive Summary).***

►Waterbody Name: **Long Plain Brook**
Segment Number: **34-09**
Station Number: **09A**
Station Name: Plum Tree Road, Sunderland
Latitude / Longitude: 42.25.54 / 72.33.17
USGS Quad Map: Mt. Toby
Objective(s) Met: **Objective 1**
This stream receives the effluent from the Sunderland State Fish Hatchery. It also receives the run-off from operational gravel pits. Concerns to this stream include nutrient loading and siltation. NOTE: If benthics deleted at this station, replace with Multi-probe, TP and NH3-N.

►Waterbody Name: **Mohawk Brook**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **MB01**
Station Name: Silver Lane, Sunderland
Latitude / Longitude: 42.26.42 / 72.33.47
USGS Quad Map: Mt. Toby
Objective(s) Met: **Objective 1**
This waterbody flows 3.5 miles from it's beginning in Greene Swamp into the Connecticut River. Mohawk Brook receives discharge from a privately operated fish hatchery. Concerns to this stream include nutrient loading and agricultural run-off. NOTE: If benthics deleted at this station, replace with Multi-probe, TP and NH3-N.

►Waterbody Name: **Eastman Brook**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **EB01**
Station Name: Meadow Street, Amherst
Latitude / Longitude: 42.24.29 / 72.32.23
USGS Quad Map: Mt. Toby

Objective(s) Met: **Objective 1**
This stream is a tributary to the Mill River (Hadley – segment 34-25). Eastman Brook receives discharges from the Cronin National Salmon Hatchery and run-off from the Amherst Golf Course. Excessive nutrient inputs may be having adverse effects upon in-stream biota. NOTE: If benthics deleted at this station, replace with Multi-probe, TP and NH3-N.

►Waterbody Name: **Fort River**
Segment Number: **34-27**
Station Number: **27A**
Station Name: Pelham Hill Road, Amherst
Latitude / Longitude: 42.22.37 / 72.29.39
USGS Quad Map: Mt. Toby
Objective(s) Met: **Objective 1**
This station is positioned at the top of this segment; near the head of the Fort River (confluence of Hawley, Adams, Heatherstone, and Amethyst Brooks). This station shall serve as a reference station to compare to downstream conditions at station 27B. NOTE: If benthics deleted at this station, replace with Multi-probe, TP and NH3-N, and bacteria.

►Waterbody Name: **Mill River (Hatfield)**
Segment Number: **34-24**
Station Number: **24A**
Station Name: Bradstreet, Hatfield
Latitude / Longitude: 42.24.41 / 72.37.35
USGS Quad Map: Mt. Holyoke
Objective(s) Met: **Objective 1**
This station is downstream of the Mill River's confluence with West Brook. At this point, the Mill River parallels Route 91 and has a cobble / sand substrate. It is the most suitable location to perform benthic surveys within the middle portion of the Mill River. Assessments of Aquatic Life at this location will evaluate any potential impacts from Route 91 and agricultural practices. NOTE: If benthics deleted at this station, replace with Multi-probe, TP and NH3-N, and bacteria.

►Waterbody Name: **Scantic River** **(DELETE)**
Segment Number: **34-30**
Station Number: **LW05SCA**
Station Name: Hancock Road, Hampden
Latitude / Longitude: 42.02.34 / 72.22.23
USGS Quad Map: Hampden
Objective(s) Met: **Objective 1**
This is a proposed Category Three water. At present, there is no WWTP servicing the town of Hampden. Recent residential developments may be impacting this stream. Adequate, but not ideal, habitat conditions exist at this station to make macroinvertebrate collection possible.

►Waterbody Name: **East Branch Mill River (Northampton)** **(DELETE)**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **BT10EMB**
Station Name: Bullard Road, Williamsburg
Latitude / Longitude: 42.23.57 / 72.43.52
USGS Quad Map: Williamsburg
Objective(s) Met: **Objective 1**
This macroinvertebrate station is part of the MADEP catalog of biocriteria stations. It is also situated upstream of the beginning of the Mill River (Northampton) segment (segment 34-28). Collection and assessment of benthic macroinvertebrates here will both continue to advance the development of biocriteria and provide a reference benchmark for macroinvertebrate assessment at station 34-28. This high gradient stream contains excellent in-stream habitat for macroinvertebrate communities.

►Waterbody Name: **Roaring Brook**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **VR03ROA**
Station Name: Roaring Brook Road, Conway

Latitude / Longitude: 42.28.20 / 72.40.19
USGS Quad Map: Williamsburg
Objective(s) Met: **Objective 1**
This water is not currently a segment. This station is also part of the MADEP biocriteria station network, a state-wide collection of stations designed to examine trends in aquatic life. This station is located upstream of two drinking water impoundments. Data from this station will be used in conjunction with a downstream station (RB01) to assess potential aquatic life impacts due to dewatering. NOTE: If benthics deleted at this station, replace with Fish Population survey.

►Waterbody Name: **Roaring Brook**
Segment Number: **34-XX (NO SEGMENT NUMBER ASSIGNED)**
Station Number: **RB01**
Station Name: Whately Glen Road, Whately
Latitude / Longitude: 42.27.47 / 72.38.53
USGS Quad Map: Williamsburg
Objective(s) Met: **Objective 1**
This station will provide information regarding aquatic life in relation with an upstream station (VR03ROA) to assess any potential impacts to aquatic life due to dewatering of this stream. NOTE: If benthics deleted at this station, replace with Fish Population survey.

8.1.4 Fish Population Monitoring:

Fish population sampling using electrofishing techniques as outlined in DWM SOP CN 75.0 may be be conducted at up to 10 total river/stream sites in the Connecticut River Watershed. These sites, meeting **Objective 1,** will coincide with the benthic sampling and habitat analysis sites. See **Table CT4** for sample station IDs, descriptions, parameters and frequencies, and **Figure CT1** for sample site locations.

In addition to the seven (7) fish population monitoring stations described in Element 8.1.1, four (4) fish community ONLY assessments are planned for the following Connecticut River Watershed stations:

►Waterbody Name: **Mill River (Hadley)** **(DELETE)**
Segment Number: **34-25**
Station Number: **25B**
Station Name: Umass Ball Field, Amherst
Latitude / Longitude: 42.23.18 / 72.32.20
USGS Quad Map: Mt. Toby
Objective(s) Met: **Objective 1**
The watershed for the upper most portion of Mill River (Hadley) is protected as a drinking water supply for the town of Amherst. The stream then flows through a heavily recreated pond (Factory Hollow Pond). Then it flows through North Amherst, various apartment complexes, and the University of Massachusetts. This is a proposed Category Three Water , with no uses assessed.

►Waterbody Name: **Fort River**
Segment Number: **34-27**
Station Number: **27A**
Station Name: Route 47, Hadley
Latitude / Longitude: 42.19.58 / 72.34.43
USGS Quad Map: Mt. Holyoke
Objective(s) Met: **Objective 1**
This river is a proposed Category Three water, with no uses assessed. Much of the water in this stream comes from Larence Swamp (a highly developed area of ground water supply). The stream meanders heavily on it's way to the Connecticut River. At this proposed location, the stream has received suburban run-off from the town of Amherst, and agricultural run-off from Mill Valley Golf Course, and several farms.

►Waterbody Name: **Mill River (Northampton)**
Segment Number: **34-28**
Station Number: **28A**

Station Name: Valley View Road, Williamsburg
Latitude / Longitude: 42.23.28 / 72.43.20
USGS Quad Map: Williamsburg
Objective(s) Met: **Objective 1**
This is the most upstream station on segment 34-28. This segment is a proposed Category Three Water , with no uses assessed. This station will be sampled in concert with station 28B. Together, they will provide us with an assessment of the Mill River (Northampton) segment (34-28), as well as document any potential impairments between these stations.

►Waterbody Name: **Broad Brook**
Segment Number: **34-18**
Station Number: **18A**
Station Name: Hendrick Street, Easthampton
Latitude / Longitude: 42.14.37 / 72.39.27
USGS Quad Map: Mt. Tom
Objective(s) Met: **Objective 1**
This is a proposed Category Three Water , with no uses assessed. It supplies water to Nashawannuck Pond (Easthampton). The pond has been the focus of a study to investigate the degradation of water quality ("Nashawannuck Pond: Watershed Restoration Project # 1998-05/319"). Assessing the fish population present in Broad Brook may help to determine the sources of impairment to Nashawannuck Pond.

8.1.5 Fish Toxics Monitoring: ***(subject to revision)***

Fish Toxics Monitoring may be conducted at three waterbodies as follows:

1. Oxbow (PALIS = 34006 (Easthampton, MA)
2. Metacomet Lake (PALIS = 34051, Belchewrtown, MA), and
3. Lake Pleasant (PALIS = 34070, Montague, MA)

Fish are collected from each waterbody on one occasion. See **Table CT4** for potential sample station IDs, descriptions, parameters and frequencies. If it occurs (subject to change), this monitoring will fulfill programmatic **Objective 3.**

8.2 Sample Requirements (bottle type, preservatives and holding times):

See Element 11 for all field and analytical requirements for samples (method SOP, bottle type, preservative, holding times, etc.).

8.3 DWM OWMID #s:

The sample numbers to be used for Connecticut River Watershed 2003 river samples are as follows: **21-0120 up to 21-0500** as needed.

For Connecticut River Watershed 2003 Lakes sampling OWMIDs, see Lakes 2003 QAPP (CN 128.0).

Table CT4. Sampling Sites, Descriptions, Parameters and Frequency for Connecticut River Watershed Monitoring *(NOTE: grey text=proposed for deletion and italics=subject to revision)*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
River/Stream Water Quality Surveys				
Connecticut River 34-01	01A	Pauchaug Meadow Boat Launch, Northfield, MA 42.42.53 / 72.27.12	Multi-probe (dissolved oxygen, pH, temperature, specific conductance), hardness, alkalinity, total phosphorus, ammonia-N (NH3-N), fecal coliform bacteria, E. coli bacteria, total suspended solids (TSS), turbidity and Chl a	Monthly for a total of 5 surveys (May through October, as needed)
(Connecticut River 34-04	04B	Hatfield Boat Launch, Hatfield, MA 42.23.37 / 72.35.23	Same as above	Same as above)
Connecticut River 34-05	05B	Riverside Park, Longmeadow / Agawam 42.01.52 / 72.36.28	Same as above *(subject to revision: Multi-probe only)*	Same as above
Connecticut River 34-02	02A	Riverview Picnic Area, Northfield, MA 42.36.45 / 72.28.46	Multi-probe (dissolved oxygen, pH, temperature, specific conductance), TP, NH3-N, fecal coliform, E. coli	Monthly for a total of 5 surveys (May through October, as needed)
Connecticut River 34-04	04A	Sunderland Bridge (Rte.116) Sunderland, MA 42.28.03 / 72.34.59	Same as above	Same as above
Connecticut River 34-04	04C	Oxbow Marina, Easthampton, MA 42.17.18 / 72.37.04	Same as above	Same as above
(Connecticut River 34-04	04D	Brunnelle's Marina, South Hadley, MA 42.15.47 / 72.35.58	Same as above	Same as above)
Connecticut River 34-05	05A	Route 90 boat launch, Springfield, MA 42.09.12 / 72.37.32	Same as above	Same as above
Millers River 35-05	*CT05*	*Route 63, Erving, MA 42.34.50 / 72.29.43*	*Total phosphorus (TP), ammonia-N (NH3-N), fecal coliform, E. coli, chl a*	*Monthly as above*
Deerfield River 33-04	*CT04*	*Route 5/10, Greenfield, MA 42.34.10 / 72.35.32*	*Same as above*	*Same as above*
Chicopee River 36-25	*CT03*	*Route 116, Chicopee, MA 42.09.00 / 72.36.27*	*Same as above*	*Same as above*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Westfield River 32-07	*CT02*	*Route 147, West Springfield, MA 42.05.24 / 72.37.36*	*Same as above*	*Same as above*
Falls River 34-XX (NO SEGMENT NUMBER ASSIGNED)	FR01	Bascom Road, Gill, MA 42.38.40 / 72.32.34	Multi-probe (dissolved oxygen, pH, temperature, specific conductance), total phosphorus (TP), ammonia-N (NH3-N), fecal coliform bacteria and E. coli bacteria	Same as above
Sawmill River 34-26	26A	South Ferry Road, Montague, MA 42.32.33 / 72.32.56	Same as above	Same as above
Fort River 34-27	27A	Route 47, Hadley, MA 42.19.58 / 72.34.43	Same as above	Same as above
Bachelor Brook 34-07	07A	Route 47, South Hadley, MA 42.16.12 / 72.35.12	Same as above	Same as above
Stony Brook 34-19	19A	Rte. 116, South Hadley, MA 42.14.47 / 72.34.49	Same as above	Same as above
Pecousic Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*PB01*	*Dwight Street, Springfield, MA 42.03.56 / 72.32.21*	*Same as above*	*Same as above*
Dingle Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*DB01*	*Tiffany Street, Springfield, MA 42.04.34 / 72.32.52*	*Same as above*	*Same as above*
Scantic River 34-30	30A	South Street, Hampden, MA 42.03.48 / 72.24.45	Same as above	Same as above
East Branch Mill River 34-XX (NO SEGMENT NUMBER ASSIGNED)	EBMR01	Mill Street, Williamsburg, MA 42.23.31 / 72.43.35	Same as above	Same as above
West Branch Mill River 34-XX (NO SEGMENT NUMBER ASSIGNED)	WBMR01	Mill Street, Williamsburg, MA 42.23.30 / 72.43.36	Same as above	Same as above
Mill River (Northampton) 34-28	28B	USGS Gage, Northampton, MA 42.19.05 / 72.39.19	Same as above	Same as above
Mill River (Hatfield) 34-24	24A	Elm Street, Hatfield, MA 42.21.59 / 72.36.17	Same as above	Same as above
Bloody Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	BB01	Whately Road, Deerfield, MA 42.28.42 / 72.37.06	Same as above	Same as above
Manhan River 34-11	*11B*	*Lovefield Street, Easthampton, MA 42.16.47 / 72.39.13*	*Same as above*	*Same as above*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Mill River (Hadley) 34-25	25A	Mill River Recreation Area, Amherst, MA 42.24.42 / 72.31.44	Multi-probe (dissolved oxygen, pH, temperature, specific conductance), hardness, alkalinity, total phosphorus, ammonia-N (NH3-N), fecal coliform bacteria, E. coli bacteria, total suspended solids (TSS) and turbidity	Same as above
Mill River (Hadley) 34-25	25C	Mill Site Road, Hadley, MA 42.23.10 / 72.33.00	Same as above	Same as above
Weston Brook 34-23	23A	Boardman Street, Belchertown, MA 42.16.15 / 72.26.59	Same as above	Same as above
Lampson Brook 34-06	06A	George Hannum Street, Belchertown, MA 42.16.54 / 72.25.39	Same as above	Same as above
Manhan River 34-11	11A	Glendale Street, Easthampton, MA 42.15.59 / 72.41.29	Same as above *(and possibly deployment of continuous temperature sensors)*	Same as above
Manhan River 34-11	11C	Fort Hill Street, Easthampton, MA 42.17.00 / 72.38.25	Same as above *(and possibly deployment of continuous temperature sensors)*	Same as above
Lake Surveys				
Arcadia Lake	34005	Arcadia Lake, Belchertown, MA.	TP, apparent color, chlorophyll a, Secchi depth Multi-probe (DO, %DO, pH, spec conductivity, temp, DO/T profile @0.5m, then 1m intervals to 0.5m above bottom) Aquatic plants (surveyed % cover, speciation)	Once a month for three months Once in late summer Once in late summer
Metacomet lake	34051	Metacomet Lake, Belchertown, MA.	Same as above	Same as above
Forge Pond	34024	Forge Pond, Granby, MA	Same as above	Same as above
Porter Lake	34073	Porter Lake, Springfield, MA	Same as above	Same as above
Porter Lake West	34072	Porter Lake West, Springfield, MA	Same as above	Same as above
Oxbow	34066	Oxbow, Easthampton, MA	Same as above	Same as above

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Benthic/Habitat Surveys (subject to revision/deletion; see Elelemt 8.1.3)				
Connecticut River	*34-01*	*Pauchaug meadow boat launch, Northfield, MA*	*Exuvia (_________________________________)*	*Three Times between May 1st and October 31st.*
Connecticut River	*34-02*	*Riverview Picnic Area, Northfield, MA*	*Same as Above*	*Same as Above*
Connecticut River	*34-04*	*Sunderland Bridge, Sunderland, MA*	*Same as Above*	*Same as Above*
Connecticut River	*34-04*	*Hatfield Boat Launch, Hatfield, MA*	*Same as Above*	*Same as Above*
Connecticut River	*34-04*	*Oxbow Marina, Easthampton, MA*	*Same as Above*	*Same as Above*
Connecticut River	*34-05*	*Route 90 Boat Launch, Springfield, MA*	*Same as Above*	*Same as Above*
Connecticut River	*34-05*	*Riverside Park, Agawam, MA*	*Same as Above*	*Same as Above*
Falls River 34-XX (NO SEGMENT NUMBER ASSIGNED)	*FR01*	*Bascom Road, Gill, MA 42.38.40 / 72.32.56*	*Macroinvertebrates; instream and riparian habitat quality. RBP III methodology*	*Once*
Sawmill River 34-26	*26A*	*South Ferry Road, Montague, MA 42.32.33 / 72.32.56*	*Same as Above*	*Once*
Long Plain Brook 34-09	*09A*	*Plum Tree Road, Sunderland, MA 42.25.54 / 72.33.17*	*Same as Above*	*Once*
Mohawk Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*MB01*	*Silver Lane, Sunderland, MA 42.26.42 / 72.33.47*	*Same as Above*	*Once*
Mill River (Hadley) 34-25	*25A*	*Mill River Recreation Area, Amherst, MA 42.24.42 / 72.31.44*	*Same as Above*	*Once*
Eastman Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*EB01*	*Meadow Street, Amherst, MA 42.24.29 / 72.32.23*	*Same as Above*	*Once*
Fort River 34-27	*27A*	*Pelham Hill Road, Amherst, MA 42.22.37 / 72.29.39*	*Same as Above*	*Once*
Fort River 34-27	*27B*	*Route 47, Hadley, MA 42.19.58 / 72.34.43*	*Same as Above*	*Once*
Stony Brook 34-19	*19A*	*Rte. 116, South Hadley, MA 42.14.47 / 72.34.49*	*Same as Above*	*Once*

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Weston Brook 34-23	*23A*	*Boardman Street, Belchertown, MA 42.16.15 / 72.26.59*	*Same as Above*	*Once*
Lampson Brook 34-06	*06A*	*George Hannum Street, Belchertown, MA 42.16.54 / 72.25.39*	*Same as Above*	*Once*
Scantic River 34-30	*LW05SCA*	*Hancock Road, Hampden, MA 42.02.34 / 72.22.23*	*Same as Above*	*Once*
East Branch Mill River 34-XX (NO SEGMENT NUMBER ASSIGNED)	*BT10EMB*	*Bullard Road, Williamsburg, MA 42.23.57 / 72.43.52*	*Same as Above*	*Once*
West Branch Mill River 34-XX (NO SEGMENT NUMBER ASSIGNED)	*WBMR01*	*Mill Street, Williamsburg, MA 42.23.30 / 72.43.36*	*Same as Above*	*Once*
Mill River (Northampton) 34-28	*28B*	*USGS Gage, Northampton, MA 42.19.05 / 72.39.19*	*Same as Above*	*Once*
Roaring Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*VR03ROA*	*Roaring Brook Road, Conway, MA 42.28.20 / 72.40.19*	*Same as Above*	*Once*
Roaring Brook 34-XX (NO SEGMENT NUMBER ASSIGNED)	*RB01*	*Whately Glen Road, Whately, MA 42.27.47 / 72.38.53*	*Same as Above*	*Once*
Fish Population Surveys				
Falls River 34-XX (NO SEGMENT NUMBER ASSIGNED)	FR01	Bascom Road, Gill, MA 42.38.40 / 72.32.56	Fish population (numbers of fish, species present)	Once
Sawmill River 34-26	26A	South Ferry Road, Montague, MA 42.32.33 / 72.32.56	Same as Above	Once
Mill River (Hadley) 34-25	*25B*	*UMASS Ball Field, Amherst, MA*	*Same as Above*	*Once*
Fort River 34-27	27A	Route 47, Hadley, MA 42.19.58 / 72.34.43	Same as Above	Once
Stony Brook 34-19	19A	Rte. 116, South Hadley, MA 42.14.47 / 72.34.49	Same as Above	Once
Weston Brook 34-23	23A	Boardman Street, Belchertown, MA 42.16.15 / 72.26.59	Same as Above	Once

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Lampson Brook 34-06	06A	George Hannum Street, Belchertown, MA 42.16.54 / 72.25.39	Same as Above	Once
Scantic River 34-30	30A	South Street, Hampden, MA 42.03.48 / 72.24.45	Same as Above	Once
Mill River (Northampton) 34-28	28A	Valley View Road, Williamsburg, MA 42.23.28 / 72.43.20	Same as Above	Once
Mill River (Northampton) 34-28	28B	USGS Gage, Northampton, MA 42.19.05 / 72.39.19	Same as Above	Once
Broad Brook 34-18	18A	Hendrick Street, Easthampton, MA 42.15.59 / 72.41.29	Same as Above	Once
Fish Toxics Surveys (subject to revision/deletion)				
Oxbow	*34066*	*Oxbow, Easthampton, MA.*	*Heavy Metals (Ar, Cd, Pb, Se, Hg) Polychlorinated Biphenyls (PCB) Organochlorine pesticides*	*Once*
Metacomet Lake	*34051*	*Metacomet Lake, Belchertown, MA.*	*Same as above*	*Once*
Lake Pleasant	*34070*	*Lake Pleasant, Montague, MA*	*Same as above*	*Once*

2003 DWM Connecticut Watershed Map

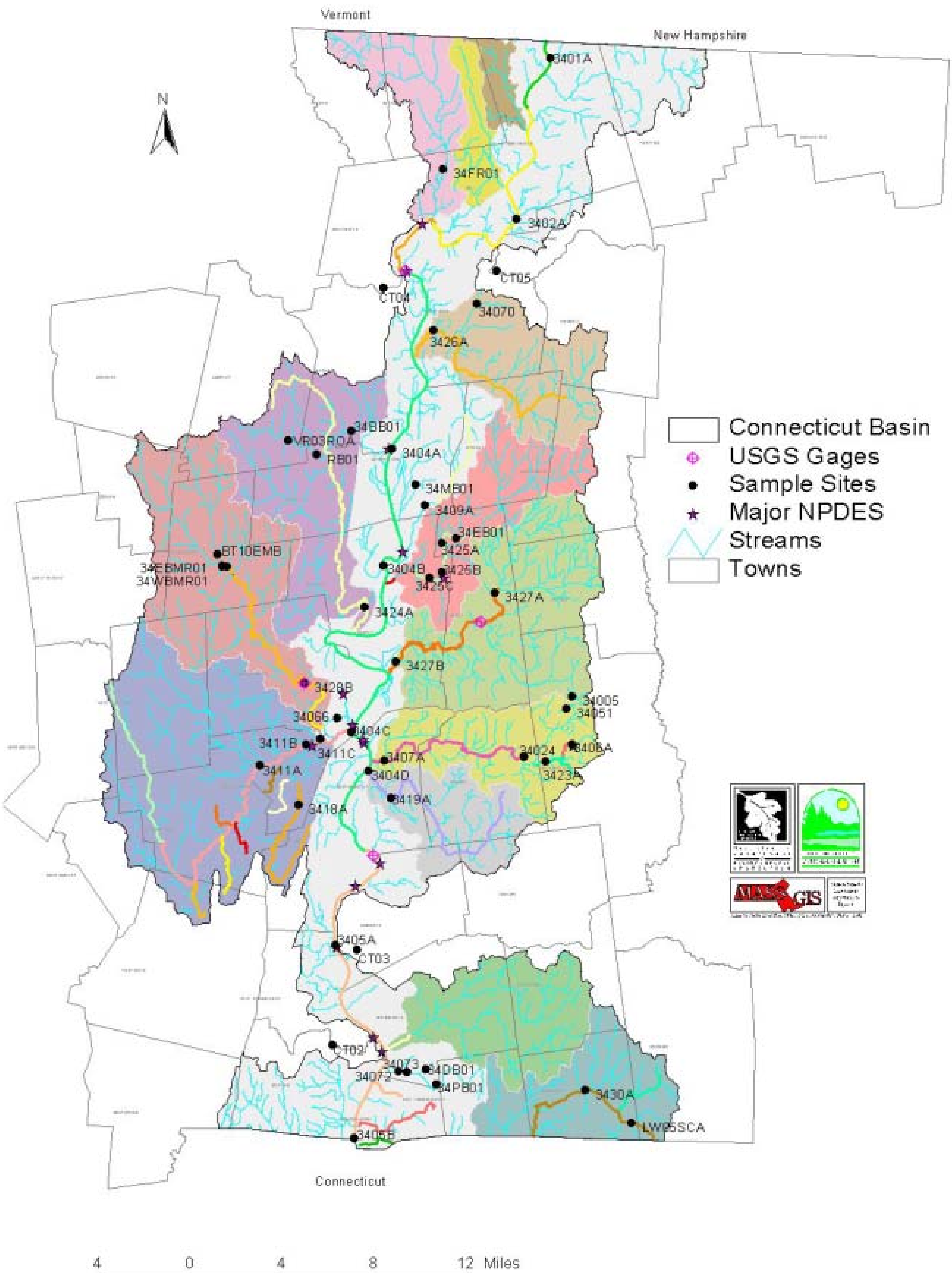

Figure CN1. Connecticut River Watershed 2003 Monitoring Locations

Nashua Watershed (2003 QAPP, Elements 5-8)

Nashua River, Station 29A, Pepperell, Ma. (July, 2002)

5.0 PROJECT DEFINITION AND BACKGROUND INFORMATION

5.1 Goals & Objectives and Intended Use of the Nashua River Watershed Data

The watershed assessment process in Massachusetts is carried out on a 5-year cycle. In Year One, the Division of Watershed Management (DWM) coordinates with watershed groups, gathers background information and begins to formulate sampling needs for streams, rivers, ponds and lakes in pre-determined watersheds. During Year Two of the cycle, sampling sites and parameters are finalized and sampling is conducted. In Year Three, the finalized data are used for assessment reporting to comply with Section 305(b) of the Clean Water Act (CWA). Implementation of specific projects or programs to address water quality problems, and post-project evaluation are conducted in Year Four and Year Five, respectively.

The goal of the Nashua River Watershed Year 2 Survey is to obtain information (chemical and biological) at a total of 34 river or tributary stations plus five lakes (phosphorus TMDL development and possibly fish toxics monitoring) that meets the following DWM programmatic objectives and watershed-specific sub-objectives.

Objective 1: Evaluate specific water bodies for support of designated uses (using Section 305(b) of the CWA), determine if State water quality standards are being met, and evaluate the level of impairment of CWA Section 303(d)-listed waterbodies.

► Evaluate water quality and aquatic habitat around selected point source discharges.

Objective 2: Provide quality-assured data for use by DWM in developing Total Maximum Daily Loads (TMDLs) for State 303(d) listed waterbodies.

► Gather data for TMDL development for Fort Pond, Lancaster; Partridge Pond, Westminster; Pepperell Pond, Pepperell/Groton; and Lake Shirley, Lunenburg; and data in support of the Nashua River Phosphorus TMDL.

Objective 3: Screen fish to provide data to the Massachusetts Department of Public Health (MDPH) for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls (PCBs) and pesticides).

► Assess screening-level fish toxicity at two lake stations (Lake Shirley, Lunenburg and East Washacum Pond, Sterling) in the Nashua River Watershed for potential public health concerns. ***(subject to revision/deletion)***

Objective 4: Provide quality-assured *E. coli* data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams, due to soon-to-be-released Massachusetts freshwater criteria for *E. coli*.

5.2 NASHUA RIVER WATERSHED STATIONS

The Nashua River Watershed and 2003 monitoring locations are shown in **Figure N1** provided at the end of Element 8.

5.3 RECENT HISTORICAL DATA

From May to October 1998, monitoring of the Nashua River Watershed was performed by MADEP's DWM. Data are available in the *Nashua River Basin 1998 Water Quality Assessment Report* (MADEP 2001). The study included in-situ Multi-probe measurements (dissolved oxygen, percent saturation, pH, temperature and specific conductivity) and sampling for chemistry (alkalinity, hardness, chloride, suspended solids and turbidity), nutrients (total phosphorus, ammonia, nitrate-nitrogen), bacteria (fecal coliform and one time for *E. coli* and *Enterococcus*) and BOD at 11 stations. Four additional stations along the mainstem were monitored for total phosphorus, dissolved phosphorus, Chlorophyll *a*, phytoplankton and Multi-probe profile measurements. Synoptic surveys were conducted on 71 lakes, ponds and impoundments in the Nashua River Watershed in 1998. DWM fish toxics monitoring was conducted at Lake Whalom, Lunenburg and Snows Millpond, Fitchburg/Westminster. Data from these surveys can be found in Appendix B of the *Nashua River Basin 1998 Water Quality Assessment Report*. The complete DWM benthic macroinvertebrate and habitat study and results can be found in Appendix C of the assessment report and Appendix D of the assessment report contains the Chlorophyll *a*, phytoplankton and periphyton results and discussion.

As a result of DWM's monitoring, in combination with data collected from outside sources, 69% of the river miles in the Nashua River Watershed were assessed for Aquatic Life Use, 2% were assessed for Fish Consumption Use, 59% were assessed for Primary and Secondary Contact Recreation Uses and 66% were assessed for the Aesthetics Use (MADEP 2001). In addition, information was presented on approximately 94% of the total lake acreage in the Nashua River Watershed.

MADEP's CERO SMART monitoring program for the Nashua River Watershed is a cooperative effort, since 1998, of MADEP's Division of Watershed Management, the Wall Experiment Station, the Nashua River Watershed Association and MADEP's Central Regional Office (MADEP 2002a). The goals of the SMART monitoring program are to *1.) Document baseline water quality, 2.) Estimate loadings at key locations, 3.) Define long term trends in water quality, 4.) Assess attainment of water quality standards, and 5.) Provide data for other programs* (MADEP 2002b). In the Nashua River Watershed, five fixed stations are sampled every other month year-round for the following parameters: dissolved oxygen, pH, conductivity, temperature, alkalinity, hardness, chloride, total suspended solids, total phosphorus, ammonia, nitrate-nitrite, total Kjeldahl nitrogen, and Microtox (when resources are available).

As a requirement under the Federal Clean Water Act (CWA), states are required "to develop information on the quality of their water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public" (MADEP 2002c). To this end, the EPA released guidance on November 19, 2001 for the preparation of an *Integrated List of Waters* that would combine reporting elements of both § 305(b) and § 303(d) of the CWA **(Table N2)**. The integrated list format allows states to provide the status of all their assessed waters in a single multi-part list. States choosing this option, as Massachusetts has, list each water body or segment thereof in one of the following five categories; with waters listed in Category 5 constituting the 303(d) List and, as such, are reviewed and approved by the EPA":

1) Unimpaired and not threatened for all designated uses;
2) Unimpaired for some uses and not assessed for others;
3) Insufficient information to make assessments for any uses;
4) Impaired or threatened for one or more uses but not requiring the calculation of a TMDL; and
5) Impaired or threatened for one or more uses and requiring a TMDL.

In June 2002, USEPA performed ambient toxicity testing at four locations on the North Nashua River and two locations on the "South Branch" Nashua River (EPA June 2002). Stations were selected to bracket four municipal wastewater treatment plants:

West Fitchburg WWTF, East Fitchburg WWTF, Leominster WWTP and Clinton WWTP. Additionally, in-situ measurements for pH, conductivity, dissolved oxygen and temperature were taken at the six stations.

The USGS operates gaging stations measuring gage height and discharge at the Nashua River at E. Pepperell, MA (USGS 01096500), Squannacook River near West Groton, MA (USGS 01096000), and North Nashua River at Fitchburg, MA (USGS 01094400) (USGS 16 December 2002). Gage height, discharge, water temperature, and specific conductance are measured at the Quinapoxet River at Canada Mills near Holden, MA (USGS 01095375). The same parameters from the Quinapoxet River are measured at the Stillwater River near Sterling, MA with the addition of precipitation data (USGS 01095220).

The MDC's Division of Watershed Management (MDC DWM) is responsible for securing and maintaining an adequate supply of high quality drinking water to meet the demands of the 46 communities served by the Massachusetts Water Resources Authority (MWRA) (MADEP 2001). Water quality sampling and watershed monitoring are an integral part of their mission. The Environmental Quality Section staff at Wachusett Reservoir conducts the sampling activities for the Wachusett Reservoir Watershed. In 1999 MDC DWM's routine water quality monitoring included sample collection from 47 stations on 36 tributaries and from four stations on the reservoir (Pistrang, et al 1999). Temperature and conductivity were measured in-situ and fecal coliform bacteria samples were collected weekly year-round at tributary stations. Quarterly sampling for pH, alkalinity, turbidity, hardness and color was performed at all tributary stations and monthly sampling for nitrate-nitrogen, nitrite-nitrogen, total phosphorus, ortho-phosphorus and algae was conducted at a subset of these stations. Four stations on the reservoir were profiled monthly for temperature, dissolved oxygen, pH and conductivity. Samples for nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, silica, alkalinity, and total phosphorus were collected monthly from the Reservoir. In 2000, ammonia-nitrogen, silica and total suspended solids were added to the monthly parameter list collected in the tributaries and one tributary was removed from the sampling plan (Pistrang, et al 2000). In 2001 the routine monitoring was scaled back to 20 stations on 15 tributaries and 5 stations on the Wachusett Reservoir (Pistrang, et al 2001). Total coliform was added as a weekly routine parameter at the tributary stations.

DFWELE's Division of Fisheries and Wildlife (DFW) performs fish population monitoring in selected watersheds each summer. Generally, DFW follows EOEA's 5 year rotating watershed schedule (Richards 2002). However, with a large area of central Massachusetts scheduled for 2003, it was necessary for DFW's central district to begin its "Year 2 pink watershed" monitoring out of sequence. Consequently, monitoring of fish population assemblages in the Nashua River Watershed began in the summer of 2002 and will continue and be completed in the summer of 2003.

The Nashua River Watershed Association (NRWA) is an environmental non-profit organization founded in 1969 (NRWA 30 October 2002). NRWA's mission is "to work for a healthy ecosystem with clean water and open spaces for human and wildlife communities, where people work together to sustain mutual economic and environmental well-being in the Nashua River watershed". NRWA has conducted a water quality monitoring program since 1993 "with the intent of building baseline information to track trends and identify "hot spots" for remediation. Volunteer monitors collect water samples from up to 40 stations on a monthly basis from April through October. Samples have been routinely analyzed for the following parameters: pH, temperature (in situ), alkalinity, dissolved oxygen; fecal coliform, and *E. coli* (in New Hampshire and at select "hot spot" sites).

The NRWA, with support of the DFWELE Riverways Program, has also organized Stream Teams in various subwatersheds since 1995 to establish stewardship of streams by local citizens, schools, businesses and civic groups (MADEP 2001). These include: Catacunemaug Brook Stream Team, Phillips Brook Stream Team, North Nashua River Fitchburg Stream Team, Nashua River Clinton Stream Team, Unkety Brook Stream Team, Nissitissit River (Squan-A-Tissit Chapter of Trout Unlimited), and the Nashua River Pepperell Stream Team (NRWA 30 October 2002). Additionally, the ongoing Monoosnuc Brook Greenway Project was formed in 1987 in response to local concern that Monoosnuc Brook was deteriorating. The NRWA, with input from the watershed communities and many groups, agencies, and individuals, created a *2020 Vision Plan for the Nashua River watershed*. The goals of the 2020 Plan are: 1.) Restore and protect water quality, 2.) Conserve open spaces and 3.) Encourage careful land use with well-planned development. "The 2020 Plan recommends four basic strategic actions: environmental education, advocacy for resource stewardship, resource-based community planning, and working together for cooperative watershed management."

5.4 DATA GAPS

The main data gap throughout the Nashua River Watershed is a lack of geographic coverage of data collection, and its subsequent analysis, necessary to perform complete water quality assessments. Wet weather surveys, which can help distinguish between pollution from stormwater or combined sewer overflows and that of illicit or failing septic and sewer systems, are another data gap that cannot be easily remedied. Personnel and laboratory scheduling are the main obstacle for the collection of wet weather samples.

Because of recent changes to the Massachusetts Surface Water Quality Standards, *E. coli* data is lacking for use in recreational contact use assessment. Changes to the standards do not reflect how drinking water sources are assessed, i.e. fecal coliform bacteria will continue to be used as the indicator for impairment to surface drinking waters. Therefore, samples collected by MDC in the Class A tributaries to the Wachusett Reservoir will not include *E. coli* bacteria assay.

Table N1. Recent Historical Data for the Nashua River Watershed

Data Source (Originating Organization)	Data Collection Type	How Data Will Be Used	Limitations on Data Use
MADEP DWM	Multi-probe in-situ measurements of dissolved oxygen, percent saturation, pH, conductivity, and temperature at 11 stations. Grab samples of alkalinity, hardness, chloride, turbidity, total phosphorus, ammonia, nitrate-nitrogen, total Kjeldahl nitrogen, total suspended solids, BOD, and bacteria (fecal coliform and *E. coli*) at 11 stations. Four stations monitored for total phosphorus, dissolved phosphorus, Chlorophyll *a*, integrated Chlorophyll *a*, phytoplankton and Multi-probe profile measurements. Lake synoptic surveys at 71 lakes, fish toxics on two lakes, benthic macroinvertebrate assemblages and habitat assessments at 14 stations.	Sampling plan design, 305(b) assessment, Nashua River Phosphorus TMDL development	Data has been published and will be out of date for MADEP's next Nashua River Watershed Water Quality Assessment Report. However, data can be used for comparison purposes to data collected in 2003.
MADEP CERO, Smart Monitoring	In-situ measurements of dissolved oxygen, percent saturation, pH, conductivity, and temperature. Grab samples for alkalinity, hardness, chloride, total suspended solids, total phosphorus, ammonia, nitrate, and total Kjeldahl nitrogen. Microtox toxicity, turbidity and flow are measured when resources are available.	Sampling plan design, 305(b) assessment, TMDL monitoring	Data usable for the assessment of the Aquatic Life Use, but limited to five stations. No bacteria data available to assess recreational uses.
US EPA – Region 1	Toxicity testing (2002) and 24-hour continuous monitoring for dissolved oxygen, pH, temperature and conductivity (2003)	Sampling plan design, 305(b) assessment	Continuous monitoring limited to one 24-hour period.
USGS	Gage height, discharge, water temperature, specific conductance and precipitation.	305(b) assessment, TMDL monitoring	Limited spatial coverage and data type.
MDC, Division of Watershed Management	Wachusett Reservoir tributary monitoring for temperature, conductivity, pH, alkalinity, turbidity, hardness, color, fecal coliform bacteria, nitrate-nitrogen, nitrite-nitrogen, total phosphorus, ortho-phosphorus, ammonia, silica, total suspended solids and algae. Reservoir profiles for temperature, dissolved oxygen, pH and conductivity and sample collection for nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, silica, alkalinity, total phosphorus and algae.	Sampling plan design, 305(b) assessment	Limited to tributaries in the Wachusett Reservoir subwatershed only. Fecal coliform bacteria data can be used for Primary and Secondary Contact Recreation Use assessment only if levels are below the drinking water standard and therefore, by default, support recreational use.
DFWELE, Division of Fisheries and Wildlife	Fish population assemblages	Sampling plan design, 305(b) assessment	Fish population assemblages usable only as secondary data with respect to Aquatic Life Use assessments.

Table N1 (cont.) Recent Historical Data for the Nashua River Watershed

Data Source (Originating Organization)	Data Collection Type	How Data Will Be Used	Limitations on Data Use
DFWELE, Adopt-a-Stream	Synoptic stream surveys	305(b) assessment	Data applicable to the Aesthetics Use only and limited to the following areas: Catacoonamug Brook, Phillips Brook, North Nashua River Fitchburg, Nashua River Clinton, Unkety Brook, Nissitissit River, and Nashua River Pepperell.
Nashua River Watershed Association	Grab samples of pH, alkalinity, dissolved oxygen, total phosphorus, fecal coliform bacteria, and *E. coli* (in New Hampshire and at select hot spot sites). Temperature measured in situ.	305(b) assessment, TMDL monitoring	QAPP approved 2001, revised QAPP under development

Table N2. Proposed 2002 Integrated List of Impaired Waterbodies (Category 5) in the Nashua River Watershed

Segment	Description	Pollutants/Stressors
Chaffin Pond* (MA81017)	Holden – 102 acres	Exotic Species
Dawson Pond* (MA81028)	Holden – 22 acres	Exotic Species
Eagle Lake* (MA81034)	Holden – 84 acres	Exotic Species
Flannagan Pond* (MA81044)	Ayer – 87 acres	Exotic Species
Robbins Pond* (MA81111)	Harvard – 15 acres	Exotic Species
Lake Samoset* (MA81116)	Leominster – 44 acres	Exotic Species
Sawmill Pond* (MA81118)	Fitchburg/Westminster – 59.3 acres	Exotic Species
Stuart Pond* (MA81137)	Sterling – 39 acres	Exotic Species
Stump Pond* (MA81171)	27 acres	Exotic Species
Unionville Pond* (MA81143)	Holden – 19 acres	Exotic Species
Lake Whalom* (MA81154)	Lunenburg – 96 acres	Exotic Species
White Pond* (MA81155)	Lancaster/Leominster – 47.7 acres	Exotic Species
Wyman Pond* (MA81161)	Westminster – 200 acres	Exotic Species
Quinapoxet River* (MA81-32)	Outlet Quinapoxet Reservoir, Holden to inlet of Wachusett Reservoir, West Boylston	Flow Alteration
Bare Hill Pond (MA81007)	Harvard – 321 acres	Metals, Noxious aquatic plants [11/2/1999/CN113.0], Exotic species
Fort Pond (MA81046)	Lancaster – 78 acres	Nutrients
Grove Pond (MA81053)	Ayer – 67 acres	Metals, Noxious aquatic plants, Exotic species
Hickory Hills Lake (MA81031)	Lunenburg – 314 acres	Metals
Mirror Lake (MA81085)	Harvard – 29 acres	Metals
Partridge Pond (MA81098)	Westminster – 24.7 acres	Noxious aquatic plants, Turbidity
Pepperell Pond (MA81167)	Pepperell – 296 acres	Metals, Nutrients, Noxious aquatic plants, Turbidity, Exotic species
Plow Shop Pond (MA81103)	Ayer – 29 acres	Metals, Noxious aquatic plants, Exotic species
Lake Shirley (MA81122)	Lunenburg – 354 acres	Noxious aquatic plants, Turbidity, Exotic species
Lake Wampanoag (MA81151)	Ashburnham/Gardner – 224 acres	Metals
Chaffins Brook (MA81-33)	Headwaters South Malden St/West Wachusett St to Unionville Pond, Holden. 0.9 miles	Cause unknown
East Wachusett Brook (MA81-30)	Headwaters northeast of Little Wachusett Mt., Princeton to confluence with Stillwater River, Sterling. 5.4 miles	Pathogens
Gates Brook (MA81-24)	Headwaters to inlet Wachusett Reservoir, West Boylston. 3.5 miles	Cause unknown, Pathogens

Table N2 (cont.) Proposed 2002 Integrated List of Impaired Waterbodies (Category 5) in the Nashua River Watershed

Segment	Description	Pollutants/Stressors
Malagasco Brook (MA81-29)	Headwaters southwest of Apron Hill through Pine Swamp to the inlet of Wachusett Reservoir (South Bay), Boylston. 2.4 miles	Cause Unknown, Organic enrichment/Low DO, Pathogens
Muddy Brook (MA81-28)	Headwaters west of Shrewsbury St. to inlet of Wachusett Reservoir (South Bay), West Boylston. 0.8 miles	Cause Unknown
Nashua River (MA81-05)	Confluence with North Nashua River, Lancaster to confluence with Squannacook River, Shirley/Groton/Ayer. Miles 26.0-12.5.	Cause Unknown, Unknown toxicity, Metals, Nutrients, Pathogens, Taste, odor and color, Turbidity
Nashua River (MA81-06)	Confluence with Squannacook River, Shirley/Groton/Ayer to Pepperell Dam, Pepperell. Miles 12.5-3.7.	Cause Unknown, Metals, Nutrients, Organic enrichment/Low DO, Noxious aquatic plants, Turbidity
Nashua River (MA81-07)	Pepperell Dam, Pepperell to New Hampshire state line, Pepperell/Dunstable. Miles 3.7-0.0	Cause Unknown, Nutrients, Pathogens, Turbidity
Nashua River “South Branch” (MA81-08)	Outlet Lancaster Millpond to Clinton WWTP, Clinton. Miles 30.6-27.6	Cause Unknown, Unknown toxicity, Pathogens
Nashua River “South Branch” (MA81-09)	Clinton WWTP, Clinton to confluence with North Nashua River, Lancaster. Miles 27.6-26.0	Cause Unknown, Pathogens, Objectionable deposits
Nissitissit River (MA81-21)	New Hampshire state line to confluence with Nashua River, Pepperell. Miles 4.5-0.0	Cause Unknown
North Nashua River (MA81-01)	Outlet Snows Millpond to Fitchburg Paper Company Dam #1, Fitchburg. Miles 19.5-18.3	Cause Unknown, Other habitat alterations, Pathogens
North Nashua River (MA81-02)	Fitchburg Paper Company Dam #1 to Fitchburg East WWTP, Fitchburg. Miles 18.3-12.0	Cause Unknown, Unknown toxicity, Pathogens, Taste, odor and color, Objectionable deposits
North Nashua River (MA81-03)	Fitchburg East WWTP Fitchburg to Leominster WWTP, Leominster. Miles 12.0-9.9	Cause Unknown, Unknown toxicity, Pathogens, Taste, odor and color, Turbidity
North Nashua River (MA81-04)	Leominster WWTP Leominster to confluence with Nashua River, Lancaster. Miles 9.9-0.0	Cause Unknown, Pathogens, Taste, odor and color, Turbidity
Squannacook River (MA81-19)	Hollingsworth and Vose WWTP, Groton/Shirley to confluence with Nashua River, Shirley/Groton/Ayer. Miles 3.6-0.0	Cause Unknown
Unnamed Tributary (MA81-35)	AKA-"Lower Chaffin Brook" - Outlet Unionville Pond to confluence with Quinapoxet River, Holden.	Cause Unknown, Organic enrichment/Low DO
Unnamed Tributary (Boylston Brook) (MA81-34)	Unnamed tributary locally known as "Boylston Brook." Headwaters north of French Drive to the confluence with Potash Brook, Boylston.	Cause Unknown

* Category 4C water “impairment not cause by a pollutant”

6.0 PROJECT OVERVIEW AND SCHEDULE

6.1 Overview of 2003 Nashua River Watershed Monitoring

6.1.1 River/Stream Monitoring:

Water quality monitoring, which includes in-situ measurements and/or grab samples, will be conducted at up to 25 locations in the Nashua River Watershed between April and October 2003. In-situ measurements for dissolved oxygen, percent saturation, temperature, pH, and specific conductivity will be obtained in the field using Multi-probes and will be conducted at 20 stations once per month May to September (3-5 rounds pre-dawn). Bacteria samples will be collected from 21 stations once per month from May to September (5 rounds post-dawn). Sampling for total phosphorus, dissolved reactive phosphorus, ammonia, total suspended solids, turbidity, and flow measurements will be conducted in April, June, August and October (for greater variation in the flow regime). Chlorophyll *a* will be sampled at 6 stations in June, August and September.

All water quality sample collection will be simple grab samples collected using wade-in and bridge drop techniques, as approved in DWM SOPs. Grab water samples will be delivered to MADEP's Senator William Wall Experiment Station in Lawrence, MA for analysis. There are no planned wet-weather surveys (noticeable increase in stream flow) or stormwater monitoring events (e.g. National Weather Service forecasted minimum precipitation of 0.25 inches/24 hours, following a minimum 3 days of antecedent dry weather) for the Nashua River Watershed in 2003.

6.1.2 Lake/Pond Monitoring:

Lake, pond or impoundment monitoring (the term "lakes" will hereafter be used to include all) for TMDL development and watershed assessment will be conducted at four lakes, in the Nashua River Watershed: Fort Pond, Partridge Pond, Pepperell Pond, and Lake Shirley. Water quality sampling will be conducted three times over the summer (June to September). Water quality measurements will include total phosphorus, chlorophyll *a*, apparent color, and Secchi depth. A Multi-probe profile and aquatic macrophyte mapping will be performed on one occasion in each lake.

6.1.3 Benthic Macroinvertebrate and Aquatic Habitat Monitoring: ***(subject to revision)***

Benthic macroinvertebrates and periphyton may be sampled, and respective habitats assessed at up to 15 stations on one occasion, mostly likely in September, using modified Rapid Bioassessment Protocol (RBP) III. Two additional stations may receive aquatic habitat assessment only. Benthic macroinvertebrate functional feeding group, community composition, pollution tolerance, and abundance metrics are calculated to determine Aquatic Life Use status. Habitat assessment scoring and general observations of instream and riparian zone habitat features are recorded.

6.1.4 Fish Toxics Monitoring: ***(subject to revision)***

Fish toxics monitoring may be conducted by DWM at Lake Shirley, Lunenburg and East Washacum Pond, Sterling. Fish are collected from each waterbody on one occasion during the summer. Edible fillets are analyzed for selected metals, PCBs, and organochlorine pesticides.

6.1.5 Fish Population Monitoring: ***(subject to revision)***

Fish population assemblages will be documented and respective habitats assessed by DWM on one occasion at up to 10 sites in the Nashua River Watershed using approved DWM SOPs. Nine of the ten sites were chosen to coincide with potential benthic macroinvertebrate stations. This work will be coordinated with the Massachusetts Division of Fisheries and Wildlife (DFW), which conducted fish population surveys in the Nashua River Watershed in 2002 and will continue in 2003.

6.2 Monitoring Schedules

See **Table N3**.

Table N3. Project Schedules for 2003 Nashua River Watershed Monitoring

Activity	Approximate Date of Initiation	Approximate Date of Completion	Deliverable	Deliverable Due Date
River/Stream Surveys:				
Coordination, meetings and reconnaissance	September, 2002	February, 2003	Draft sampling plan; meeting notes, etc.	April, 2003
River/stream sampling plan development	October, 2002	February, 2003	Internal DWM concurrence on sampling plan	April, 2003
2003 DWM Monitoring QAPP	October, 2002	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Water Quality Sampling Events, Rounds 1-8	March, 2003	October, 2003	Field data; lab samples to WES	March-October, 2003
Data QA/QC review and validation	January, 2004	March, 2004	2003 Data Validation Report	March, 2004
Nashua River Watershed Assessment Report	October, 2003	December, 2004	Nashua River Watershed Assessment Report	December, 2004
Lake Surveys:				
2003 Lakes Baseline TMDL QAPP development, review and approval	November, 2002	March, 2003	2003 Lakes Baseline TMDL QAPP	March, 2003
2003 DWM monitoring QAPP	October, 2002	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Lakes sampling surveys (3 rounds)	June, 2003	September, 2003	Field data; lab samples	June-September, 2003
Aquatic plant surveys	August, 2003	September, 2003	Field data; plant maps	October, 2003
Preliminary survey report	December, 2003	January, 2004	Technical memorandum	January, 2004
Data QA/QC review and validation	January, 2004	March, 2004	2003 Data Validation Report	March, 2004
Nashua River Watershed Assessment Report	October, 2003	December, 2004	Nashua River Watershed Assessment Report	December, 2004
Draft TMDL Reports for Nashua lakes	January, 2004	December, 2004	Draft TMDL Reports	December, 2004
Benthic Macroinvertebrate/Aquatic Habitat Surveys: (subject to revision)				
2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP development, review and approval	*November, 2002*	*February, 2003*	*2003 Benthic Macroinvertebrate/Aquatic Habitat QAPP*	*March, 2003*
Macroinvertebrate/Habitat sampling surveys (1 round)	*September, 2003*	*September, 2003*	*Field data; benthic samples to DWM*	*September, 2003*
Macroinvertebrate/Habitat Assessment Technical Memorandum	*October, 2003*	*2004*	*Macroinvertebrate/Habitat Assessment Technical Memorandum*	*2004*
Nashua River Watershed Assessment Report	October, 2003	December, 2004	Nashua River Watershed Assessment Report	December, 2004

Table N3 (cont.) Project Schedules for 2003 Nashua River Watershed Monitoring

Activity	Approximate Date of Initiation	Approximate Date of Completion	Deliverable	Deliverable Due Date
Fish Population Surveys*: *(subject to revision)				
2003 DWM Monitoring QAPP	October, 2002	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Fish Population sampling surveys (1 round)	*September, 2003*	*September, 2003*	*Field data*	*September, 2003*
Fish Population data review, analysis and preliminary reporting	*September, 2003*	*2004*	*Fish Population Technical Memorandum*	*2004*
Nashua River Watershed Assessment Report	October, 2003	December, 2004	Nashua River Watershed Assessment Report	December, 2004
Fish Toxics Surveys*: *(subject to revision)				
2003 DWM Monitoring QAPP	October, 2002	April, 2003	2003 DWM Monitoring QAPP	April, 2003
Fish Toxics sampling surveys (1 round)	*July, 2003*	*July, 2003*	*Field data; lab samples*	*July, 2003*
Fish Toxics data review and preliminary report	*September, 2003*	*2004*	*Fish Toxics Technical Memorandum*	*2004*
Nashua River Watershed Assessment Report	October, 2003	December, 2004	Nashua River Watershed Assessment Report	December, 2004

7.0 DATA QUALITY OBJECTIVES and PERFORMANCE CRITERIA

Monitoring data for the Nashua River watershed will meet the specific data quality objectives (DQOs) outlined in Element 13. Not meeting these planned DQOs may subject project data to qualification or censoring during post-monitoring quality control review (see Elements 16-19 for discussion of data assessment and validation).

8.0 SAMPLING DESIGN

For a description of DWM's general approach to watershed monitoring, see the Executive Summary.

8.1 Design Rationale for 2003 Nashua River Watershed Monitoring

8.1.1 River/Stream Monitoring:

The proposed Nashua River watershed water quality and bacteria monitoring in 2003 will be at 26 locations throughout the watershed, where simple grab samples and/or in-situ Multi-probe measurements (dissolved oxygen, percent saturation, pH, temperature and conductivity) will be taken. Field measurements for dissolved oxygen, pH, temperature, and conductivity will be taken pre-dawn only during the summer low-flow, in order to represent "worst case scenarios", and grab samples (via wade-in or bridge drop) will be taken post-dawn.

See **Table N4** for river/stream sample station IDs, descriptions, parameters and frequencies. A rationale for each station listed hydrologically is as follows. It can be assumed in the following text that "bacteria" sampling includes fecal coliform and *E. coli*.

NOTE: Many of the following stations are subject to revisions/deletions related to benthic macroinvertebrates, habitat assessment and fish toxics monitoring (as explained in the Executive Summary); potential deletions are shown as greyed text .

Wachusett Reservoir Sub-basin

Most of the designated segments in the Wachusett Reservoir Sub-basin will be sampled by the Metropolitan District Commission's Division of Watershed Management (MDC DWM). Previous water quality assessments were based on MDC's data and reported in MADEP's *Nashua River Basin 1998 Water Quality Assessment Report*.

Quinapoxet River (Segment MA81-32, 7.9 miles)
This Class A public water supply was assessed as supporting the Primary and Secondary Contact Recreation and Aesthetics Uses in MADEP's *Nashua River Basin 1998 Water Quality Assessment Report*. The Aquatic Life Use was supported in the lower 3.4 miles of this segment and assessed as non-support for the upper 4.5 miles because of reduced flow due to hydromodification. Field reconnaissance by DWM in the summer of 1998 revealed a dry riverbed and no water flowing from the Quinapoxet Reservoir.

- **Station QP10** [Monitoring Objective 1]
  An aquatic habitat assessment will be performed upstream from Princeton Road, Holden, MA to determine the potential effects of flow control at the Quinapoxet Reservoir.
- **Station QP00** [Monitoring Objective 1]
  Benthic macroinvertebrate and habitat assessment station QP00 is located downstream from River Street, Holden, MA.

Stillwater River (Segment MA81-31, 6.7 miles)
This Class A public water supply was assessed as supporting the Aquatic Life, Primary and Secondary Contact Recreation and Aesthetics Uses in MADEP's *Nashua River Basin 1998 Water Quality Assessment Report*. Overall habitat quality in this segment is high as noted by MADEP DWM's habitat assessment in 1998.

- **Station SL00** [Monitoring Objective 1]
  Benthic macroinvertebrate and habitat assessment station SL00 is located upstream from Crowley Road, West Boylston, MA. This site will serve as the benthic macroinvertebrate regional reference station for the Nashua River Watershed.

“South Branch” Nashua River Subbasin

Nashua River “South Branch" (Segment MA81-08, 3.0 miles)

This segment of the “South Branch” Nashua River; from the outlet of Lancaster Mill Pond to the MWRA Clinton WWTP, Clinton; is on the 2002 Integrated List (Category 5) for cause unknown, unknown toxicity and pathogens. The Aquatic Life and Primary and Secondary Contact Recreation Uses were assessed as partial support and the Aesthetics Use was supported in the *Nashua River Basin 1998 Water Quality Assessment Report*.

- **Station NS17** [Monitoring Objectives 1 and 4]
  Station NS17 is located upstream from Route 110, Clinton, MA and upstream from the MWRA Clinton WWTP outfall. Parameters to be measured at this station include: Multi-probe, TP, NH_3-N, TSS, bacteria, fish population, *benthic macroinvertebrate and habitat assessment*. Additional sampling for Dissolved Reactive Phosphorus (DRP), in support of the Nashua River TMDL, will be conducted at this station. *Benthic macroinvertebrate assemblages from this site will be compared to the regional reference station on the Stillwater River and will be used as an upstream comparison for benthic station NS19 downstream from the MWRA Clinton WWTP outfall.*

Nashua River “South Branch" (Segment MA81-09, 1.6 miles)

This segment of the “South Branch” Nashua River; from the MWRA Clinton WWTP to the confluence with the North Nashua River in Lancaster; is on the 2002 Integrated List (Category 5) for cause unknown, pathogens, and objectionable deposits. The Aquatic Life and Primary Contact Recreation Uses were non-supported and the Secondary Contact Recreation and Aesthetics Uses were assessed as partial support in the *Nashua River Basin 1998 Water Quality Assessment Report*. This segment of the Nashua River receives the discharge from the MWRA Clinton Wastewater Treatment Plant. MWRA Clinton is not able to meet their permit limits for copper and is currently under an EPA order to address the copper violations (Chen 2002). Additionally, runoff from two EPA SAND (Sites Awaiting NPL Decision) sites in Clinton (Clinton Rigby Brook and National Perforating Corp) flow to this segment of the “South Branch” Nashua River (USEPA 20 November 2002). “Several sampling events conducted between 1981 and 1996 on the Clinton Rigby Brook SAND site indicated the presence of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals in the surface water and sediment. In 1996, surface water and sediment samples were collected from Rigby Brook at the National Perforating site and surrounding properties. Several VOCs, SVOCs, and metals detected in these sediment samples were also detected in groundwater and soil samples previously collected from the facility.”

- **Station NS19** [Monitoring Objectives 1 and 4]
  Station NS19 is located upstream from Bolton Road, Lancaster, MA and downstream from the MWRA Clinton WWTP outfall. Parameters to be measured at this station include: Multi-probe, TP, bacteria, Chlorophyll *a*, fish population, benthic macroinvertebrate assemblages and habitat assessment. Additional sampling for DRP, in support of the Nashua River TMDL, will be conducted at this station. Benthic macroinvertebrate assemblages from this station will be compared to Station NS17 (and to the regional reference station) to determine the extent, if any, of impacts from the MWRA Clinton WWTP discharge.

North Nashua River Subbasin

Whitman River (Segment MA81-11, 6.7 miles)

The Aquatic Life and Aesthetics Uses for the Whitman River were assessed as support in the *Nashua River Basin 1998 Water Quality Assessment Report*, with an “Alert Status” issued to the Aquatic Life Use. All other uses were not assessed. There are indications from DWM’s 1996 biocriteria survey that the Whitman River may be stressed due to excessive nutrients. The Whitman River is the largest tributary entering the North Nashua River upstream from the West Fitchburg Wastewater Treatment Facility.

- **Station NT34** [Monitoring Objectives 1 and 4]
  Multi-probe, TP, NH_3-N, TSS, bacteria, fish population, and benthic macroinvertebrate and habitat assessment station NT34 is located upstream from Route 2A, Westminster, MA.

North Nashua River (Segment MA81-01, 1.2 miles)

This segment of the North Nashua River, from the outlet of Snows Millpond to the Fitchburg Paper Company Dam #1, Fitchburg, is on the 2002 Integrated List (Category 5) for cause unknown, other habitat alterations, and pathogens. In MADEP’s *Nashua River Basin 1998 Water Quality Assessment Report*, the Aquatic Life Use was supported for the upper 0.2 miles of this segment and assessed as partial support for the lower 1.0 mile. Primary and Secondary Contact Recreation Uses were assessed as non-support while the Aesthetics Use was supported for the entire segment. This segment of the North Nashua River receives the discharge from the West Fitchburg Wastewater Treatment Facility. Flow to the West Fitchburg WWTF is approximately 3.4 mgd, although the NPDES permit allows for 10.5 mgd (Chen 2002). Greater than 90% of the flow is generated from paper mills and the rest is domestic. Effluent from the West Fitchburg

WWTF meets discharge limits most of the time but occasionally exceeds the ammonia limit. The City of Fitchburg is under an EPA order to address the ammonia violations by the end of 2003. The City is working on redirecting the domestic flow (sole source of ammonia) to the easterly plant for treatment and disposal.

- **Station NN03** [Monitoring Objectives 1 and 4]
  Station NN03 is located downstream from the Mill #9 bridge, Fitchburg, MA and downstream from the West Fitchburg WWTF outfall. Parameters to be measured at this station include: Multi-probe, TP, NH_3-N, TSS, bacteria, fish population, benthic macroinvertebrate assemblages and habitat assessment.

Flag Brook (Segment MA81-10, 2.7 miles)
All designated uses for Flag Brook were not assessed in MADEP's *Nashua River Basin 1998 Water Quality Assessment Report.* Flag Brook has been identified as a "water stressed" subbasin by the EOEA watershed team (Carr, 14 November 2002). Two Water Management Act (WMA) users operate facilities in the 12.7 square-mile Flag Brook subbasin. One of these WMA users has not submitted an annual report since 1993.

- **Station FLG01** [Monitoring Objective 1]
  A habitat assessment will be performed off Princeton Road, Fitchburg, MA to help identify the extent, if any, of impacts to aquatic habitat from dam operations or Water Management Act (WMA) users.

Phillips Brook (Segment MA81-12, 8.0 miles)
All designated uses were not assessed in DEP's *Nashua River Basin 1998 Water Quality Assessment Report*. Phillips Brook drains a 15.8 square-mile mostly forested area (74%). Agricultural and residential activity make up the largest portion of the remaining land use in the Phillips Brook subwatershed.

- **Station PH00** [Monitoring Objectives 1 and 4]
  Multi-probe, TP, NH_3-N, and bacteria. Station PH00 is located downstream from Westminster Hill Road, Fitchburg, MA.

North Nashua River (Segment MA81-02, 6.3 miles)
This segment of the North Nashua River, from the Fitchburg Paper Company Dam #1 to the Fitchburg East WWTF, is on the 2002 Integrated List (Category 5) for cause unknown, unknown toxicity, pathogens; taste, odor and color; and objectionable deposits. The Aquatic Life, Primary and Secondary Contact Recreation and Aesthetics Uses were all assessed as non-support in the *Nashua River Basin 1998 Water Quality Assessment Report*. East Fitchburg WWTF is permitted to discharge storm water/wastewater from CSO's throughout this segment. During wet weather, flow to the East Fitchburg facility from the City's combined sewer system increases significantly (sometimes to over 20 mgd) (Chen 2002). During these wet weather events, part of the flow bypasses the biological treatment system (after primary settling) to avoid biomass being flushed out. However, all discharge flows are disinfected. The facility's effluent exceeds its discharge limits during wet weather often for BOD, TSS, fecal coliform, and settleable solids, sometimes for pH and total phosphorous, and occasionally for total residual chlorine. As part of their NPDES permit requirements, water from this segment of the North Branch Nashua River was collected just upstream of the East Fitchburg WWTF discharge (to Segment MA81-03) for use as dilution water in the facility's whole effluent toxicity tests. The river water frequently exhibited toxicity and, therefore, since July 2001, laboratory water has been substituted as the diluent for *P. promelas* toxicity testing. River water is currently used as a test control only (no longer used to make up the dilution series).

- **Station NN09** [Monitoring Objectives 1 and 4]
  Multi-probe, TP, NH_3-N, TSS, bacteria, turbidity, fish population, and benthic macroinvertebrate and habitat assessment. Station NN09 is located upstream from Falulah Road and upstream from the East Fitchburg WWTF outfall, Fitchburg, MA.

North Nashua River (Segment MA81-03, 2.1 miles)
This segment of the North Nashua River, from the East Fitchburg WWTF to the Leominster WWTP, is on the 2002 Integrated List (Category 5) for cause unknown, unknown toxicity, pathogens; taste, odor and color; and turbidity. The East Fitchburg Wastewater Treatment Facility is permitted to discharge treated wastewater (12.4 average monthly mgd) to this segment of the North Nashua River (MADEP 2002d). The permit was issued in September 2002 and expires September 30th, 2005. Additionally the East Fitchburg WWTF is permitted to discharge storm water/wastewater from CSO's upstream from this segment (See Segment MA81-02).

- **Station NN10A** [Monitoring Objectives 1 and 4]
  Station NN10A is located behind Searstown Mall, just downstream from Route 2, Leominster, MA, and downstream from the East Fitchburg WWTF outfall. Parameters to be measured at this station include: Multi-probe, TP, NH_3-N, TSS, bacteria, turbidity, fish population, and benthic macroinvertebrate and habitat assessment.

Monoosnuc Brook (Segment MA81-13, 6.1 miles)
All designated uses were not assessed for Monoosnuc Brook in the *Nashua River Basin 1998 Water Quality Assessment Report*. Monoosnuc Brook joins the North Nashua River approximately 200 meters upstream from the Leominster WWTP and drains an 11.4 square-mile, mostly forested, area. "In 1987, the Monoosnuc Brook Greenway Project (MBGP) was formed as part of the Nashua River Watershed Association (NRWA 16 December 2002). The project was in response to the concerns of local businesses and City officials who noted the neglect and deterioration of the brook which had become littered with garbage. Through cleanups, site work, education and other events, the MBGP has been successful at restoring the beauty of the brook. Seriously neglected and abused until the late 1980s, the Monoosnuc Brook is now again a valuable asset to Leominster. The Greenway Project has become an ongoing community-based effort, ensuring that the Monoosnuc Brook remains a valuable asset to the City of Leominster."

- **Station MON00** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS and bacteria station MON00 is located upstream from the road to Searstown Mall, Leominster, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

North Nashua River (Segment MA81-04, 9.9 miles)
This segment of the North Nashua River from the Leominster WWTP outfall to the confluence with the mainstem Nashua River is on the 2002 Integrated List (Category 5) for cause unknown, pathogens; taste, odor and color; and turbidity. The Aquatic Life, Secondary Contact Recreation and Aesthetics Uses were assessed as partial support while the Primary Contact Recreation Use was non-supported in the *Nashua River Basin 1998 Water Quality Assessment Report*. This segment receives the discharge from the Leominster WWTP and a smaller 0.006 MGD sanitary wastewater discharge (recently upgraded) from River Terrace Healthcare.

- **Station NN12** [Monitoring Objectives 1 and 4]
  Station NN12, located downstream from the Route 190 bridge, Lancaster, MA and downstream from the Leominster WWTP discharge is sampled by MADEP CERO as part of the SMART monitoring program. Bacteria, TP, turbidity, Chlorophyll *a* and pre-dawn Multi-probe monitoring will be conducted to supplement data collected by MADEP CERO.
- **Station NN13** [Monitoring Objective 1]
  Fish population, benthic macroinvertebrate and habitat assessment station NN13 is located off Route 70 at Ponakin Mill, Lancaster, MA and is downstream from the Leominster WWTP discharge.

Mainstem Nashua River Subbasin

Nashua River (Segment MA81-05, 13.5 miles)
This segment of the Nashua River, from the confluence with the North Nashua River to the confluence with the Squannacook River, is on the 2002 Integrated List (Category 5) for cause unknown, unknown toxicity, metals, nutrients, pathogens; taste, odor and color; and turbidity. In the *Nashua River Basin 1998 Water Quality Assessment Report*, the Aquatic Life Use was assessed as non-support for this entire segment. Additionally the lower 2.9 miles of this segment, downstream from the Icehouse Dam impoundment, did not support the Primary and Secondary Contact Recreation and Aesthetics Uses; while the 10.6-mile stretch upstream from the impoundment was supported for these same uses. This segment of the Nashua River receives the treated effluent from the Ayer Wastewater Treatment Plant. The permit for Ayer was issued in July 2000 and allows an average monthly flow of 1.79 MGD (MADEP 2000). Ayer WWTP collects ambient water upstream from its outfall for use as diluent in its toxicity testing. This ambient water is screened for general chemistry parameters and selected metals. Additional bacteria and nutrient sampling in this segment of the Nashua River was recommended in MADEP's assessment report in order to reevaluate the contact recreational uses following the connection of MCI Shirley's wastewater discharge to the Devens WWTP (groundwater discharge) and to evaluate Ayer's NPDES compliance with their total phosphorus nutrient limit.

- **Station NM21** [Monitoring Objectives 1 and 4]
  Station NM21 located downstream from tank bridge, Harvard, MA and upstream from the Ayer WWTP is sampled by MADEP CERO as part of the SMART monitoring program. Pre-dawn Multi-probe, TP, turbidity and bacteria monitoring will be conducted to supplement data collected by MADEP CERO.
- **Station NM23** [Monitoring Objectives 1 and 2]
  TP, DRP, NH_3-N, TSS, turbidity and Chlorophyll *a* samples will be collected upstream from Ayer Road, Shirley/Harvard (upstream from the Ice House Dam and upstream from Ayer WWTP, Harvard, MA). These samples will supplement EPA's continuous monitors to be deployed near this station.
- **Station NM23B** [Monitoring Objective 1]

Fish population, benthic macroinvertebrate and habitat assessment station NM23B is located downstream from McPhearson Road railroad bridge, Ayer/Shirley, MA and upstream from the Ayer WWTP**.**

- **Station NM25** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, DRP, NH_3-N, TSS, turbidity, and bacteria station NM25 is located downstream from Route 2A and downstream from the Ayer WWTP, Shirley/Ayer, MA.

Still River (Segment MA81-15, 3.1 miles)
All designated uses were not assessed in the Still River in the *Nashua River Basin 1998 Water Quality Assessment Report*. The Still River originates in the wetlands of the Bolton Flats State Wildlife Management Area. Reconnaissance in November 2002 showed a significant amount of duckweed present at Route 117 in Bolton, MA. Based on the Nashua River Phosphorus TMDL model and land use literature data, the Still River is one of the seven tributaries with the highest overall loading per sub-watershed, and has the highest unit area loading per hectare (Hartman 2002).

- **Station STL01** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS, and bacteria station STL01 is located upstream from Route 117, Bolton, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

Catacoonamug Brook (Segment MA81-16, 2.5 miles)
All designated uses were not assessed in Catacoonamug Brook in the *Nashua River Basin 1998 Water Quality Assessment Report*. The Catacunemaug Brook stream team describes this brook as a "wonderful resource for the town of Lunenburg and provides excellent riparian, wildlife and habitat assessment." Half of the land use in the Catacoonamug Brook subbasin is forested with residential and agricultural uses making up another third.

- **Station CAT00** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS, and bacteria station CAT00 is located upstream from Lovell Road, Shirley, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

Nonacoicus Brook (Segment MA81-17, 1.5 miles)
All designated uses were not assessed for Nonacoicus Brook in the *Nashua River Basin 1998 Water Quality Assessment Report.*

- **Station NON00** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS, and bacteria station NON00 is located upstream from the road to Moore Airfield, Ayer, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

Mulpus Brook (Segment MA81-22, 11.85 miles)
All designated uses were not assessed for Mulpus Brook in the *Nashua River Basin 1998 Water Quality Assessment Report*.

- **Station MPB02** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS, and bacteria station MPB02 is located upstream from Lawton Road, Shirley, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

Nashua River (Segment MA81-06)
This segment of the Nashua River; from the confluence with Squannacook River, Shirley/Groton/Ayer to Pepperell Dam, Pepperell, MA is on the 2002 Integrated List (Category 5) for cause unknown, metals, nutrients, organic enrichment/low DO, noxious aquatic plants, and turbidity. The Groton School WWTP discharges to this segment of the Nashua River.

- **Station GROTSCH** [Monitoring Objectives 1 and 2]
  Samples for TP, DRP and Chlorophyll *a*, in support of the Nashua River TMDL, will be collected off the center of the floating wharf at the Groton School boathouse, east of Route 111, Groton, MA.
- **Station INLTPEPPD** [Monitoring Objectives 1, 2 and 4]
  Samples for TP, DRP, NH3-N, TSS, turbidity, bacteria and Chlorophyll *a* will be collected upstream from Route 111/119, Groton, MA.

Squannacook River (Segment MA81-18)
The Aquatic Life, Primary and Secondary Contact Recreation and Aesthetics issues were assessed as support in the *Nashua River Basin 1998 Water Quality Assessment Report*. "Alert Status", however, was applied to the Aquatic Life Use due to elevated temperature readings in the downstream portion of this cold water fishery.

- **Station SQ10** [Monitoring Objectives 1 and 2]
  Station SQ10 is located upstream from Old Turnpike Road, Townsend. Parameters collected at this station are limited to those needed for the Nashua River phosphorus TMDL: TP, DRP and flow measurements.
- **Station SQ05** [Monitoring Objectives 1 and 2]
  Station SQ05 is located downstream from South Street and downstream from Harbor Pond, Townsend. Parameters collected at this station are limited to those needed for the Nashua River phosphorus TMDL: TP, DRP and flow measurements. <u>Additionally, continuous temperature monitors will be deployed in the reach of the Squannacook River between Harbor Pond and the Hollingsworth & Vose Company.</u>
- **Station NT60A** [Monitoring Objectives 1, 2 and 4]
  Station NT60A, located off the west side of Townsend Road (directly across from Candice Lane), Groton, MA, is sampled by MADEP CERO as part of the SMART monitoring program. Pre-dawn Multi-probe, TP, DRP, bacteria and fish population monitoring will be conducted to supplement data collected by MADEP CERO.

Squannacook River (Segment MA81-19)
Segment MA81-19 of the Squannacook River, from the Hollingsworth and Vose WWTP to the confluence with the Nashua River, is on the 2002 Integrated List (Category 5) for cause unknown. The Aquatic Life Use was assessed as partial support while the Aesthetics Use was supported in the *Nashua River Basin 1998 Water Quality Assessment Report*. Primary and Secondary Recreation Uses were not assessed in this segment.

- **Station NT61** [Monitoring Objectives 1, 2 and 4]
  Station NT61 is located downstream from Route 225, Shirley/Groton, MA. Parameters collected at this station include: Multi-probe, TP, NH_3-N, TSS, bacteria, fish population, benthic macroinvertebrate and habitat assessment. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

James Brook (Segment MA81-20, 4.4 miles)
All designated uses were not assessed for James Brook in the *Nashua River Basin 1998 Water Quality Assessment Report.*

- **Station JAM01** [Monitoring Objectives 1, 2 and 4]
  Multi-probe, TP, NH_3-N, TSS, and bacteria station JAM01 is located upstream from Shirley Road, Ayer/Groton, MA. Additional sampling for DRP and flow measurements, in support of the Nashua River TMDL, will be conducted at this station.

Nashua River (Segment MA81-07, 3.7 miles)
This segment of the Nashua River, from the Pepperell Dam to the New Hampshire state line, is on the 2002 Integrated List (Category 5) for cause unknown, nutrients, pathogens and turbidity. The Aquatic Life and Primary Contact Recreation uses were impaired (either non-support or partial support) for this entire segment. The Secondary Contact Recreation and Aesthetics Uses were assessed as partial support for the upper 1.0 mile from the Pepperell Pond Dam to the confluence with the Nissitissit River and supported for the lower 2.7 miles. This segment receives the treated sanitary discharge from Pepperell Wastewater Treatment Plant and a cooling water/wastewater/stormwater discharge from Indeck Pepperell Power. An industrial discharge from Merrimac Paper existed until July 2002 when the company closed (MPC 2003).

- **Station NM29** [Monitoring Objective 1]
  Benthic macroinvertebrate and habitat assessment station NM29 is located approximately 130 meters downstream from the covered bridge at Groton St, Pepperell, MA, downstream from the Indeck Pepperell Power discharge and upstream from the Pepperell WWTP.
- **Station NM29A** [Monitoring Objectives 1 and 4]
  Station NM29A is located approximately 650 meters downstream from the covered bridge at Groton St, Pepperell, MA (downstream from the Indeck Pepperell Power discharge and upstream from the Pepperell WWTP) and is sampled by MADEP CERO as part of the SMART monitoring program. Pre-dawn Multi-probe, TP, DRP, turbidity, Chlorophyll *a* and bacteria monitoring will be conducted to supplement data collected by MADEP CERO.
- **Station NM30** [Monitoring Objective 1]
  Benthic macroinvertebrate and habitat assessment station NM30 is located downstream from Route 111, Hollis, NH. This station is located downstream from the two discharges on Segment MA81-07.

Nissitissit River (Segment MA81-21, 4.5 miles)
The Nissitissit River; from the New Hampshire state line to the confluence with the Nashua River, Pepperell, MA; is on the 2002 Category 5 Integrated List of Impaired waters for cause unknown. The Primary and Secondary Contact Recreation and Aesthetics Uses were supported for this entire segment in the *Nashua River Basin 1998 Water Quality Assessment Report*, as was the Aquatic Life Use in the upper 3.3 miles. The lower 1.2 miles of this segment was impaired for the Aquatic Life Use.

- **Segment NT67** [Monitoring Objectives 1 and 2]
  Benthic macroinvertebrate and habitat assessment station NT67 is located downstream from Prescott Street and upstream from the impoundment at Route 111, Pepperell, MA.
- **Segment NT68** [Monitoring Objectives 1, 2 and 4]
  Station NT68 is located downstream from Mill Street and downstream from the impoundment at Route 111, Pepperell, MA. Parameters to be measured at this station include: Multi-probe, TP, NH_3-N, bacteria, and benthic macroinvertebrate and habitat assessment

8.1.2 Lake/Pond Monitoring:

Lake water quality surveys in the Nashua River Watershed will be conducted three times between June and September 2003 at a total of four lakes. Due to limitations on time and resources, samples will be taken at one deep-hole station. In order to increase the number of lakes visited using limited staff, a Multi-probe profile for dissolved oxygen, temperature, conductivity, and pH will be performed during one round only, except in Pepperell Pond where a Multi-probe profile will be recorded three times over the summer. Grab samples for TP, apparent color and chlorophyll *a* will be taken on each of the three rounds. Aquatic macrophyte mapping will be performed on one occasion in each lake.

See **Table N4** for the list of lakes and ponds to be sampled, along with sample station IDs, descriptions, parameters and frequencies. See the 2003 Baseline Lakes TMDL QAPP (CN 128.0) for station locator maps and additional information.

To meet Monitoring Objectives 1 and 2, the four lakes to be surveyed in the Nashua River Watershed are: Fort Pond, Lancaster; Partridge Pond, Westminster; Pepperell Pond, Pepperell/Groton; and Lake Shirley, Lunenburg

8.1.3 Benthic Macroinvertebrate, Periphyton and Aquatic Habitat Monitoring:

Benthic macroinvertebrate and periphyton sampling and aquatic habitat assessments may be performed at up to 15 locations in the Nashua River Watershed to investigate the effects of various point source and nonpoint source stressors on resident aquatic communities and to assess the Aquatic Life Use on selected river segments. Two additional stations may receive aquatic habitat assessments in order to identify possible flow constraints on those stream segments. All benthic stations were historically monitored and chosen to determine if water quality and habitat conditions have improved or worsened over time. One round of monitoring (most probably in September) may be performed. [Monitoring Objective 1]

The biological sampling methodology described in DWM SOP CN 39.0 (In-Stream Macroinvertebrate Monitoring) is used. The bio-survey, based on the EPA RBP III method, focuses on the number and type of benthic macroinvertebrates in selected representative river/stream reaches, and is supplemented with an assessment of habitat quality at each study site.

See **Table N4** for benthic/habitat sample station IDs, descriptions, parameters and frequencies. Also, see separate DWM document, *2003 QAPP for Macroinvertebrate Biomonitoring* (CN147.0), for further discussion of benthic macroinvertebrate sampling and habitat assessment.

8.1.4 Fish Population Monitoring:

Fish population sampling (numbers of fish, species present, length and weight) using electrofishing techniques will be conducted at up to 10 river stations in the Nashua River Watershed. Nine of these stations will coincide with benthic macroinvertebrate sites. The tenth station is located in a stretch of the cold-water fishery portion of the Squannacook River where temperature exceedances were noted in MADEP's last water quality assessment report. [Monitoring Objective 1]

Consistent with MADEP's 5-year watershed cycle, the Massachusetts Division of Fisheries and Wildlife (MDFW) is sampling fish assemblages in the Nashua River Watershed in 2002 and 2003.

See **Table N4** for fish population sample station IDs, descriptions, parameters and frequencies.

8.1.5 Fish Tissue Toxics Monitoring:

Monitoring for fish tissue contaminants may be conducted at two lakes, Lake Shirley, Lunenburg and East Washacum Pond, Sterling, in the Nashua River Watershed. Fish are collected from each waterbody on one occasion. The sampling is done using electrofishing techniques as outlined in DWM SOP CN 40.0. [Monitoring Objective 3]

8.2 Sample Requirements (bottle type, preservatives and holding times):

See Element 11 for all field and analytical requirements for samples (method SOP, bottle type, preservative, holding times, etc.).

8.3 DWM OWMID #s:

The sample numbers to be used for the Nashua River Watershed 2003 river water quality samples are as follows: **81-0140 up to 81-0500,** as needed.

For the Nashua River Watershed 2003 Lakes sampling OWMIDs, see the Lakes 2003 QAPP (CN 128.0).

Table N4. Sampling Sites, Descriptions, Parameters and Frequency for Nashua River Watershed Monitoring

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
River/Stream Water Quality Surveys				
Nashua River "South Branch" (MA81-08)	NS17	upstream from Route 110, Clinton , MA and approximately 10 yards upstream from the Clinton WWTP outfall	Multi-probe (DO, %DO, pH, specific conductance, temperature), Total Phosphorus (TP), Dissolved Reactive Phosphorus (DRP), Ammonia-nitrogen (NH3-N), Total Suspended Solids (TSS), bacteria (fecal coliform and *E. coli*)	Single grab samples taken during 5 post-dawn surveys. Multi-probe deployed for 3-5 pre-dawn surveys.
Nashua River "South Branch" (MA81-09)	NS19	upstream from Bolton Road, Lancaster, MA and downstream from the Clinton WWTP outfall	Multi-probe, TP, DRP, bacteria, Chlorophyll *a*	Same as station NS17, except Chlorophyll *a* only three times
North Nashua River (MA81-01)	NN03	downstream from the Mill #9 bridge and downstream from West Fitchburg WWTF, Fitchburg, MA	Multi-probe, TP, NH3-N, TSS, bacteria	Same as station NS17
Whitman River (MA81-11)	NT34	upstream from Route 2A, Westminster, MA	Multi-probe, TP, NH3-N, TSS, bacteria	Same as station NS17
Phillips Brook (MA81-12)	PH00	downstream from Westminster Hill Road, Fitchburg, MA	Multi-probe, TP, NH3-N, bacteria	Same as station NS17
North Nashua River (MA81-02)	NN09	downstream from Falulah Road and upstream from the East Fitchburg WWTF outfall, Fitchburg, MA	Multi-probe, TP, NH3-N, TSS, turbidity, bacteria, Microtox®	Same as station NS17
North Nashua River (MA81-03)	NN10A	Downstream from Route 2 and from the East Fitchburg WWTP, (behind Searstown Mall), Leominster, MA	Multi-probe, TP, NH3-N, TSS, turbidity, bacteria	Same as station NS17
Monoosnuc Brook (MA81-13)	MON00	upstream from the road to Searstown Mall, Leominster, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
North Nashua River (MA81-04)	NN12	downstream from the Route 190 bridge, Lancaster, MA and downstream from the Leominster WWTP discharge	Multi-probe, TP, turbidity, bacteria, Chlorophyll *a*	Same as station NS17, except Chlorophyll *a* only three times
Nashua River (MA81-05)	NM21	downstream from tank bridge, Harvard, MA and upstream from Ayer WWTP	Multi-probe, TP, turbidity, bacteria; flow (bridge-board) (or NM25)	Same as station NS17
	NM23	upstream from Ayer Road, Shirley/Harvard, MA and upstream from Ayer WWTP	TP, DRP, NH3-N, TSS, turbidity, Chlorophyll *a*, continuous DO monitors (deployed by EPA)	Same as station NS17, except Chlorophyll *a* only 3 times, one time deployment of continuous monitors
	NM25	downstream from Route 2A Shirley/Ayer, MA and downstream from Ayer WWTP	Multi-probe, TP, DRP, NH3-N, TSS, turbidity, bacteria, flow (bridge-board) (or NM21)	Same as station NS17

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Still River (MA81-15)	STL01	upstream from Route 117, Bolton, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
Catacoonamug Brook (MA81-16)	CAT00	upstream from Lovell Road, Shirley, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
Nonacoicus Brook (MA81-17)	NON00	upstream from the road to Moore Airfield, Ayer, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
Mulpus Brook (MA81-22)	MPB02	upstream from Hazen Road, Shirley, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
Nashua River (MA81-06)	GROTSCH	off the center of floating wharf at Groton School boat house, east of Route 111, Groton, MA	TP, DRP, Chlorophyll *a*, continuous DO monitors (deployed by EPA)	Same as station NS17, except Chlorophyll *a* only 3 times, one time deployment of continuous monitors
	INLTPEPPD	approximately 75 yards upstream from Route 111/119, Groton, MA	TP, DRP, NH3-N, TSS, turbidity, bacteria, flow, Chlorophyll *a*, continuous DO monitors (deployed by EPA)	Same as station NS17, except Chlorophyll *a* only 3 times, one time deployment of continuous monitors
Squannacook River (MA81-18)	SQ10	upstream from Old Turnpike Road, Townsend, MA	TP, DRP, flow	Same as station NS17
	SQ05	downstream from South Street, Townsend, MA	TP, DRP, flow	Same as station NS17
	NT60A	off the west side of Townsend Road (directly across from Candice Lane), Groton, MA	Multi-probe, TP, DRP, bacteria	Same as station NS17
Squannacook River (MA81-19)	NT61	downstream from Route 225, Shirley/Groton, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
James Brook (MA81-20)	JAM01	upstream from Route 111, Ayer, MA	Multi-probe, TP, DRP, NH3-N, TSS, bacteria, flow	Same as station NS17
Nashua River (MA81-07)	NM29A	approximately 1/2 mile downstream from covered bridge at Groton Street, Pepperell, MA (Pepperell Braiding)	Multi-probe, TP, DRP, turbidity, bacteria, Chlorophyll *a*	Same as station NS17
Nissitissit River (MA81-21)	NT68	downstream from Mill Street, Pepperell, MA	Multi-probe, TP, NH3-N, bacteria	Same as station NS17
Lake Surveys				

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
Fort Pond	MA81046	78 acres, Lancaster, MA	TP, apparent color, chlorophyll a, Secchi depth Multi-probe, (DO, %DO, pH, spec conductivity, temperature, DO/T profile @ 0.5m, then 1m intervals to 0.5m above bottom) Aquatic plants (surveyed % cover, speciation)	Once per month for three months Once in late summer Once in late summer
Partridge Pond	MA81098	24.7 acres, Westminster, MA	Same as above	Same as above
Pepperell Pond	MA81167	296 acres, Pepperell/Groton, MA	Same as above	Same as above, except 3 times for Multi-probe profile
Lake Shirley	MA81122	354 acres, Lunenburg, MA	Same as above	Same as above
Benthic Macroinvertebrate, Fish Population and Habitat Surveys (subject to deletion)				
Stillwater River (MA81-31)	SL00	upstream from Crowley Road, West Boylston, MA	Benthic macroinvertebrate and habitat assessment	Once
Quinapoxet River (MA81-32)	QP10	upstream from Princeton Road, Holden, MA	Habitat assessment only	Once
Quinapoxet River (MA81-32)	QP00	downstream from River Street, Holden (Canada Mills), MA	Benthic macroinvertebrate and habitat assessment	Once
Nashua River "South Branch" (MA81-08)	NS17	upstream from Route 110, Clinton, MA and approximately 10 yards upstream from the Clinton WWTP	Benthic macroinvertebrate, habitat assessment and fish population	Once
Nashua River "South Branch" (MA81-09)	NS19	upstream from Bolton Road, Lancaster, MA and downstream from the Clinton WWTP	Benthic macroinvertebrate, habitat assessment and fish population	Once
North Nashua River (MA81-01)	NN03	downstream from the Mill #9 bridge, and downstream from West Fitchburg WWTF, Fitchburg, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
Flag Brook (MA81-10)	FLG01	off Princeton Road, Fitchburg, MA	Habitat Assessment only	Once
Whitman River (MA81-11)	NT34	upstream from Route 2A, Westminster, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
North Nashua River (MA81-02)	NN09	downstream from Falulah Road and upstream from the East Fitchburg WWTF outfall, Fitchburg, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once

Sampling Site Name	Station ID#	Site Description	Parameters	Frequency
North Nashua River (MA81-03)	NN10A	downstream from Route 2 and from the East Fitchburg WWTP, (behind Searstown Mall), Leominster, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
North Nashua River (MA81-04)	NN13	at Ponakin Mill (upstream from closed bridge east of Ponakin Rd. dead-end), Lancaster, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
Nashua River (MA81-05)	NM23B	downstream from McPhearson Road railroad bridge, Ayer/Shirley, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
Squannacook River (MA81-18)	NT60A	off the west side of Townsend Road (directly across from Candice Lane), Groton, MA	Fish population and habitat assessment	Once
Squannacook River (MA81-19)	NT61	downstream from Route 225, Shirley/Groton, MA	Benthic macroinvertebrate, habitat assessment and fish population	Once
Nashua River (MA81-07)	NM29	approximately 130 meters downstream from the covered bridge at Groton St, Pepperell, MA	Benthic macroinvertebrate and habitat assessment	Once
Nissitissit River (MA81-21)	NT67	downstream from Prescott Street, Pepperell, MA	Benthic macroinvertebrate and habitat assessment	Once
	NT68	downstream from Mill Street, Pepperell, MA	Benthic macroinvertebrate and habitat assessment	Once
Nashua River (not a segment)	NM30	downstream from Route 111, Hollis, NH	Benthic macroinvertebrate and habitat assessment	Once
Fish Toxics Surveys (subject to deletion)				
Lake Shirley	MA81122	354 acres, Lunenburg, MA	Heavy Metals (As, Cd, Pb, Se, Hg) Polychlorinated Biphenyls (PCBs) Organochlorine pesticides	Once
East Washacum Pond	MA81035	188 acres, Sterling, MA	Same as above	Once

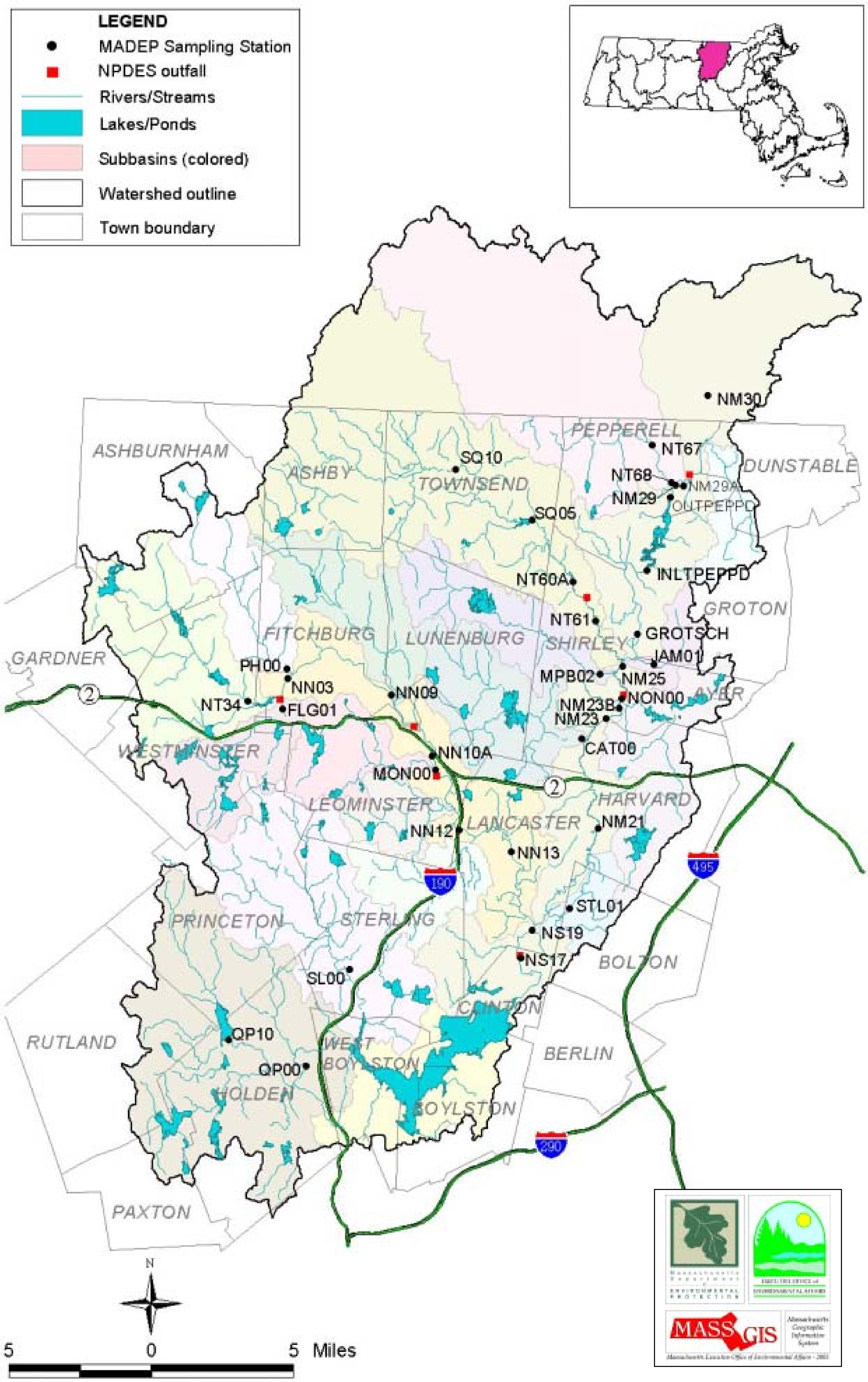

Figure N1: Nashua River Watershed 2003 Sampling Locations

9.0 FIELD SAMPLING REQUIREMENTS AND PROCEDURES

9.1 DWM Water Quality Sample Collection SOPs (CN 1.2, CN 4.2)

All 2003 field sampling for all Year 2 "pink" watershed monitoring will follow the DWM's SOP for sample collection (CN 1.2) and SOP for Multi-probe (D.O., Temperature, Specific Conductance and pH) (CN 4.2). In addition to detailing how samples should be collected, these SOPs addresses adherence to standard safety protocols, field documentation, chain-of-custody, and parameter SOPs.

9.2 Standard Protocols

See ***Appendix A*** for a summary of additional standard methods and procedures to be used by DWM in 2003 related to field sampling and analysis. Detailed SOPs are available from DWM on the 2003 QAPP CD, and/or by request.

9.3 Field Safety

With regard to personal safety, the survey coordinators and crewmembers shall use best professional judgment at all times, and at no time allow personal safety to be compromised. In addition, all crewmembers have been generally instructed what to do in the event of an emergency.

A complete First aid kit containing basic first aid equipment shall be brought (in the vehicle) on each field survey. In situations where sampling stations are far from the vehicle, crews have been instructed to take the first aid kit to the station. At least one member of the survey team shall be trained in cardiopulmonary resuscitation (CPR) and basic first aid procedures. An Adult CPR Review training course was held at DWM's Worcester office on March 12, 2003 and attended by 18-20 DWM staff.

All crewmembers shall bring personal protective gear, such as raingear, footgear (i.e., hip boots), plastic gloves, safety glasses (for acid preservation of samples), sunscreen, insect repellant, and disposable hand towels. Some of these items are provided in the standard Field Kit, which shall accompany each survey. Each crewmember is expected to dress appropriately for the season and weather. Each crewmember has been advised to wear orange, reflective safety vests at all times during a survey, especially when sampling in high vehicular traffic areas. These vests are available at DWM, Worcester. To assist crews in preparation, a survey trip checklist and field kit checklist can be used (see ***Appendix D***).

If available, a portable, cellular phone may be brought on each trip, and inclusion of personal cellular phones on surveys is encouraged.

9.4 Field Documentation

9.4.1 Field Notebook:

Field notebooks can be used to record detailed information at each site, including but not limited to the following: Site location, ID #, date/time, personnel present, recorded field data, lab samples taken, air temperature, weather, percent cloud cover, approx. wind speed and direction, staff gage height will be recorded when applicable, unusual events/sightings observed, etc.. In most cases, the field notebook provides additional information, as well as desired duplication of information provided in the DWM Field Sheet. If used, copies of field notebook pages become part of the hard copy file for the project.

9.4.2 Field Sheets:

In order to provide a permanent record of field activities and to detect possible sampling error, observations made and measurements taken in the field will be recorded on 2003 DWM Field Sheet forms. The field sheet is the main tool used by DWM to record field data. An individual field sheet is used for each station per sampling event for river/stream monitoring. Samples of the 2003 DWM Field Sheets for lakes and rivers can be found in ***Appendix D***. Note: DWM anticipates that these fieldsheets will be revised sometime in 2003 to incorporate additional and/or revised data elements necessary for the National EPA STORET database.

Typical information required on the current 2003 DWM field sheet includes, but is not limited to:
- Site name and watershed location
- Station Description
- Station Access Information

- Sample Name and ID #
- Personnel on-site performing the sampling
- Dates and times of sample collection
- Pertinent observations regarding uses (aquatic life, recreation, etc.)
- Summary of weather conditions
- Site observations and any aberrant sample handling comments
- Sample collection information (sample collection methods and devices, sample collection depth /heights, sample preservation information, matrix sampled, etc.).

Each sheet must be completed on-site at the time sampling occurs. Upon completion of the survey, each completed field sheet is submitted to the QA Analyst for hard copy filing.

9.5 Bottle Group, Bottle Type, Preservation Methods and Holding Times for 2003 Analytes

Bottle group designations, bottle types used, preservation methods used and analytical holding times for 2003 water and tissue sample analytes are shown in ***Table 2***. DWM will use bottles from two labs in 2003--- WES and Severn Trent Labs-Westfield (contract lab).

9.6 Field Quality Control (QC Samples and Training)

See ***Tables 4-6*** for quality control requirements for water quality analytes, multiprobe parameters (including continuous deployment) and for continuous temperature sensors, respectively.

<u>Field sample replication for estimating overall precision will be through the taking of co-located, simultaneous, duplicate grab samples at approx. 10% of the total number of samples and a minimum of one per survey per analyte group.</u>

<u>In addition, ambient field blanks shall also be taken at 10% of total samples to evaluate blank contamination from field activities.</u>

Training sessions for DWM survey crew staff were held in March-April, 2003 to ensure that field measurements and samples will be taken consistent with accepted, approved DWM SOPs.

9.7 Multi-probe Field Instruments

The calibration and maintenance schedule for multi-probe field instruments is shown in ***Table 3***. DWM employs both Hydrolab®, Series 3/Series 4 multi-probes and YSI 600XLM mini-sondes.

9.8 Continuous Temperature Data Loggers

Subject to staff availability, continuous temperature data loggers may be used in 2003 in one or more watersheds. See ***Table 6***.

Table 2: Bottle Group, Bottle Type, Preservation Method and Holding Times for 2003 Analytes

Group Designation	B	C	N	P	S	A/I	R	D	T
Bottle Group	Bacteria	Chemistry	Nutrient	Dissolved Phosphorus	Solids	Algae	Apparent Color	BOD	Microtox
ANALYTE #1	Fecal Coliform SM9222D	Alkalinity (titrimetric) SM2320B (EPA310.1)	Ammonia-N (auto-phenate) SM4500 - NH_3-H (EPA350.1)	Dissolved Reactive P SM4500P-E	Suspended Solids SM2540D	Chlorophyll-a (I) SM10200H	Apparent Color SM2120B (EPA110.2)	Biological Oxygen Demand (5 day) SM5210B (EPA405.1)	Toxicity
ANALYTE #2	E. Coli MTEC SM9213D Modified MTEC, EPA 1103.1	Chloride (titrimetric) $SM4500CL^{-}B$	Nitrate/Nitrite-N (auto–hydrazine) SM4500-NO_3-H (EPA353.1)		Turbidity SM2130B (EPA180.1)	Phytoplankton Identification (A1)		Biological Oxygen Demand (21-day "ultimate") SM5210C	
ANALYTE #3		Hardness SM2340B)	Total Kjeldahl Nitrogen (block digester) EPA351.2			Phytoplankton Counts (A2) SM10200F			
ANALYTE #4		Turbidity SM2130B (EPA180.1)	Total Phosphorus SM4500P-E (EPA 365.2) or EPA365.4 auto			Periphyton ID (A3)			
ANALYTE #5		Specific Conductance SM2510B (EPA120.1)				Periphyton biomass (A4)			
Matrix	Water	Water	Water	Water	Water	Water	Water	Water	Water
Bottle Type	120-1000 ml secure capped HDPE sterile preserved	500-1000 ml HDPE foam lined caps ; pre-cleaned	500 – 1000 ml HDPE foam lined caps; pre-cleaned	500-1000 ml HDPE foam lined caps; pre-cleaned	1000 ml HDPE foam lined caps; pre-cleaned	- 250-1000 ml HDPE foamlined caps, pre-cleaned (I) - 2-4 dram glass vials w/ screw cap inside 1 liter bottle (A2, A3)	120 ml HDPE Teflon™ lined caps;	1000 ml HDPE foam lined caps;(long term – 2000ml, glass) pre-cleaned	250ml amber glass Teflon™ lined caps; pre-cleaned
Preservative	Thiosulfate (if suspected Cl-residual); 4 °C and headspace	4 °C	1:1 H_2SO_4 & 4 °C	Field filtering is preferred; lab filter ASAP; 4 °C	4 °C	- 4 °C & dark (I) - water inside vial (A1, A3) - 90% acetone/ice or Lugol's (A2, A4)	4 °C	4 °C & dark	4 °C & no headspace
Holding Time	6 hr delivery time to lab; analyze within 8 hours	14 days 28days for Chloride/SpCond 48hr for Turbid 6 months for Hardness	28 days (unfrozen); TP samples can be frozen for up to 6 months prior to analysis	48 hr	7 days (TSS) 48hr (Turbid)	Process within 24 hr; If necessary, filter and freeze filters wrapped in foil for up to 3 weeks (24 days) (I)	48 hr	48 hr	48 hr

Group Designation		PAH (tissue)	PCB (tissue)	M (tissue)			
Bottle Group		Poly Aromatic Hydrocarbons	Poly-chlorinated Biphenyls/Organochlorine Pesticides	Metals			
ANALYTE #1		Multi-component EPA 625	Multi-component (Tissue) AOAC 983.21, including arochlor mixtures and congenors	Hg (cold vapor) SM3112B (EPA245.1)			
ANALYTE #2				Cd (ICP) SM3120B (EPA200.7)			
ANALYTE #3				As (STGFAA) SM3113 (EPA200.9)			
ANALYTE #4				Pb (ICP) SM3120B (EPA200.7)			
ANALYTE #5				Se (STGFAA) SM3113 (EPA200.9)			
Matrix		tissue (by special request only)	tissue	tissue			
"Bottle Type"		Whole fish packed in ice and transported to DWM lab; fish are filleted and wrapped in individual foil wraps	Whole fish packed in ice and transported to DWM lab; fish are filleted and wrapped in individual foil wraps	Whole fish packed in ice and transported to DWM lab; fish are filleted and wrapped in individual foil wraps			
Preservative		Ice to DWM lab; foil wrapped samples are frozen until delivery to WES (within 14 days); frozen until analysis; 4 C/dark for sample extracts	Ice to DWM lab; foil wrapped samples are frozen until delivery to WES (within 14 days); frozen until analysis; 4 C/dark for sample extracts	Ice to DWM lab; foil wrapped samples are frozen until delivery to WES (within 14 days); frozen until analysis; 4 C/dark for sample extracts			
Holding Time		Up to 1 year for frozen samples 14 days for sample extract	Up to 1 year for frozen samples 14 days for sample extract	6 months			

Table 3: Field Sampling *Instruments* Calibration and Maintenance

Instrument	Person(s) Responsible	Frequency of Calibration	Inspection Activity and Frequency	Maintenance Activity and Frequency	Testing Activity and Frequency	Corrective Action (CA)	SOP Reference
Hydrolab® Series 3/4 Multi-probe	Jeff Smith, Multiprobe Coordinator Richard Chase, QA/QC Analyst	Monthly and/or before each use	Visual & Electronic; Monthly and/or before each use	Hardware & Software Repair and maintenance as needed.	Pre & Post Calibration & QC checks; Monthly and before each use	Re-calibrate as necessary during pre-calibration; censoring or qualifying data if post-survey check indicates excessive drift or inaccuracies.	CN 4.2
YSI 600XLM Multi-probe	Jeff Smith and Richard Chase	Monthly and/or before each use	Visual & Electronic; Monthly and/or before each use	Hardware & Software Repair and maintenance as needed.	Pre & Post Calibration & QC checks; Monthly and before each use	Re-calibrate as necessary during pre-calibration; censoring or qualifying data if post-survey check indicates excessive drift or inaccuracies.	CN 4.2
Velocity Meters (for flow measurement) 1) Price AA 2) Teledyne-Gurley 3) Swoffer 4) Sontek ADV FlowTracker	Jeff Smith, Richard Chase and user	Before each use	Visual & Electronic; Before and after each use	Inspect post-use for damage; lubricate parts as needed per SOP. Also, repair and maintenance as needed.	Prior to each use in the lab; filed testing in Spring prior to seasonal use.	Re-calibrate as necessary. If repair and/or re-calibration ineffective, replace with alternate device.	CN 68.0
Lowrance depthfinder (lakes)	Mark Mattson	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	CN 128.0
Master-Flex peristaltic pump	Richard Chase	NA	Before each use (in the lab)	As needed.	Before each use (in the lab).	Repair as needed.	CN 1.2
Eutechnics thermometer (NIST-traceable)	Richard Chase	Every 2 years, or as needed based on QC checks.	Visual & Electronic; Before and after each use	As needed.	Annual (Spring) QC check against WES Lab NIST-certified thermometer per SOP.	Send to manufacturer for re-calibration per SOP.	CN 103.0
Onset Optic Stowaway® Temp Loggers	Richard Chase	NA	Visual & Electronic; Before, during and after each use; if possible, review data while deployed to ensure working order and accuracy	NA	Annual (Spring) QC check against DWM thermometer and PC Network clock, per SOP. QC checks	Replace with working sensor.	CN 103.0

Table 4. Field Sampling Quality Control Requirements for *Water Quality Analytes* (e.g. TP, DRP, NH3-N, TSS, Turbidity, Fecal Coliform, E. coli bacteria, Chlorophyll a, etc.)

	Frequency	Method/SOP QC Acceptance Limits	Corrective Action	Persons Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Ambient Field Blanks	**Minimum 10% of samples collected, and a minimum of 1 per event**	**No target analytes exceeding MDL**	Qualify or censor data as necessary	Survey Coordinator and QA Officer	Accuracy (contamination)	**No target analytes exceeding MDL**
Field Duplicates	**Minimum 10% of samples collected, and a minimum of 1 per event**	**RPD Precision limits vary depending on parameter (see Element 13)**	Evaluate and compare lab dups and field dups (overall precision) Censor or qualify data as necessary	Survey Coordinator and QA Officer	Overall Precision	**Generally, RPD ≤20%, but varies depending on parameter**
Performance Evaluation Sample (PES)	One time delivery to WES (nutrients, bacteria) and to STL lab (bacteria)	Parameter-dependent; same as QC/PT acceptance criteria for purchased samples	To be determined	QC Analyst and WES/STL lab, as appropriate	Accuracy	Same as QC/PT sample acceptance criteria and dependent on analyte
Cooler Temperature Blank	Each cooler	1-5 deg. C	Add more ice; drain cooler water	Survey crew leader	Accuracy (preservation)	1-5 deg. C

Table 5. Field Analytical Quality Control Requirements for *Multi-Probe Instruments* (D.O., pH, Conductivity, Temperature, TDS, Salinity, % D.O. Saturation, Depth)

	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Persons Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Pre-Calibration (or pre-deployment)	**Before every trip**	See SOP (CN 4.2) and Multi-Probe Manual(s)	Re-calibrate to within allowable specs.	Multi-Probe Coordinator & QC Analyst	Accuracy/bias Contamination	See SOP (CN 4.2) and Multi-Probe Manual(s)
Field Duplicate reading (Lakes only)	**10% of sites**	**RPD < 5-10%**	Re-deploy and start reading sequence again	Field survey crew leader	General precision	**RPD < 5-10%**
Instrument Blank	After Pre & Post Daily Calibration	No target compounds> lowest calibration standard	Retest and/or qualify data	Multi-Probe Coordinator & QC Analyst	Accuracy/bias Contamination	No target compounds> lowest calibration level
Post-Survey (or post-deployment) Check and User Report	**After every trip**	See SOP (CN 4.2) and Multi-Probe Manual(s)	If outside acceptance limits, discard or qualify data	Multi-Probe Coordinator & QC Analyst	Accuracy/bias Contamination	See SOP (CN 4.2) and Multi-Probe Manual(s)

Table 6 Field Analytical Quality Control Requirements for *Continuous Temperature Loggers* (high frequency interval continuous temperature readings)

	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Persons Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Pre-Deployment QC Check	Before every use for each sensor	**+/- 0.2 deg. C**	Replace with more accurate sensor	Project Coordinator & QC Analyst	Accuracy (temperature and time) compared against NIST-traceable thermometer and DWM-Worcester computer network clock	See SOP (CN 103.0) and sensor specifications
During-Deployment QC checks (Field Duplicate readings)	Each sensor; min. 1X/month (or more freq. for shorter duration deployments)	**+/- 0.2 deg. C**	Replace with more accurate sensor; re-deploy	Project Coordinator & QC Analyst	Accuracy as above	See SOP (CN 103.0) and sensor specifications
Post-Deployment Checks	After every use for each sensor	**+/- 0.2 deg. C**	If data outside acceptance limits, discard or qualify data	Project Coordinator & QC Analyst	Accuracy as above thermometer	See SOP (CN 103.0) and sensor specifications

10.0 SAMPLE HANDLING AND TRACKING

10.1 Assignment of Sample Field Numbers/Labels

The Database Manager has provided each Survey Coordinator with sample identification numbers or OWMIDs. These numbers are also posted in the DWM lab for use and to record which numbers have already been used. This, in combination with DWM training, will avoid the use of duplicate OWMIDs. An example of the required container label displaying the OWMIDs is shown in ***Appendix I***. Labels shall be filled out and affixed to bottles prior to bottles getting wet (i.e., used and/or placed in coolers).

10.2 Sample Preservation/Transport

Required water quality sample preservation and handling is described in Element 9, ***Table 2.***

All bacteria, TSS and turbidity samples taken in the Chicopee and Connecticut Watersheds will be delivered to Severn Trent Labs (STL) in Westfield, Massachusetts (tentative contract laboratory under BRP-2003-01) for analysis. All other sample analytes from these two watersheds will be delivered to Wall Experiment Station (WES) in Lawrence, Ma. for analysis. All samples taken in the Blackstone and Nashua Watersheds will also be delivered to WES for analysis.

Transport of samples to WES and STL will be done as quickly as possible and within sample analyte holding times. Samples not delivered or analyzed within required holding times will most probably be qualified or censored, as part of the data validation process. <u>If samples are delivered by a person(s) that was not involved in taking the sample, the COC form will be filled out and signed off during the transfer.</u>

Samples for Dissolved Reactive Phosphorus (DRP) analysis will be taken in a separate nutrients bottle and lab-filtered ASAP. These samples will be placed on ice immediately after they are taken and delivered to the lab unacidified. WES shall filter these samples the same day and ASAP. Analysis will be performed within 48 hours.

Due to potential problems with sample bottle labels coming off for bottles obtained from Severn Trent Labs (tentative and TBD), sample bottles may need to be wiped dry after filling and placed in plastic bags in coolers to keep them dry. WES sample bottles can be placed on ice in coolers with or without plastic bag containment (sample bottle labels do not degrade and fall off when wet).

10.3 Chain-of-Custody (COC) Forms

Current and to-be-developed (later in 2003) WES Chain-of-Custody (COC) forms will be used to transfer sample custody from DWM staff to the WES lab staff. Similarly, COC forms will also be used to transfer sample custody from DWM staff to the Severn Trent (tentative) contract lab. See ***Appendix I*** for sample forms. The proper procedure for filling out a COC form and transferring sample custody is documented in the respective laboratory Quality Assurance Plans.

DWM samples kept temporarily in cold storage (4 deg. C) at the DWM lab will be documented on the COC form using the signature lines (i.e., sign into fridge, then sign out of fridge). When field samples arrive at the WES/ Severn Trent (tentative) labs, the DWM staff relinquishes custody of samples to the laboratory staff. The sample containers are then removed from the shipping or transportation cooler and visually inspected for damage such as leakage, breakage, or contamination. The samples received are then compared with accompanying custody and analysis specification forms to make sure that the paperwork agrees with the labels on each sample container. All individuals who handle samples are required to sign and date the COC forms. Once completed and signed by all involved in the transaction, WES/Severn Trent (tentative) shall provide a copy of the completed form to the sample delivery crew or person. After samples have been officially transferred and assigned laboratory identification numbers, they are stored, distributed and analyzed according to the procedures detailed in each laboratory's Quality Assurance Plan.

10.4 WES/Severn Trent (tentative) Lab Sample Tracking

The Wall Experiment Station (WES) stores data in a LIMS system and on hard copy to ensure protection of records and documents. Hard copy data including logbooks, data analysis books, chain of custody forms and log-in sheets are archived for storage within a secure building. See the laboratory's Quality Assurance Plan for further data storage information.

While they do have a LIMS system in place, Severn Trent Laboratories, Inc. shall perform sample tracking in accordance with their Quality Manual, using a variety of tools, such as lab notebooks, computer files and COC forms to maintain sample integrity and ensure proper sample documentation.

11.0 FIELD ANALYTICAL METHOD REQUIREMENTS

See Element 9.0 for all information pertaining to DWM field monitoring activity, including instrumentation, analytical method requirements and required quality control samples.

12.0 LABORATORY METHODS REQUIREMENTS AND PROCEDURES

12.1 WES and Severn Trent Laboratory SOPs and Quality Assurance Plans

All samples will be analyzed using standard protocols contained in accepted WES, DWM and Severn Trent lab (tentative) SOPs and consistent with each lab's laboratory Quality Assurance Plans (QAPs). ***Table 7*** summarizes the 2003 analytical lab services.

As of 3/2003, the Severn Trent Laboratory (STL-Westfield) is currently certified by MADEP for analysis of all but one of the 2003 DWM monitoring parameters that DWM is requesting them to perform. This includes TSS and turbidity (non-potable) and E.coli bacteria (potable). As recently as 9/2001, STL-Westfield was State-certified for the remaining requested analyte --- fecal coliform bacteria. To maintain certification a laboratory must participate in and pass one Proficiency Testing study in a calendar year. STL-Westfield has not performed a proficiency test (PT) for fecal coliform in source water by SM9222D since May 2000. To regain certification, STL-Westfield plans to participate in and pass two PT studies out of three with the studies at least 30 days apart. (pers. comms., Ann Marie Allen, MADEP and Richard Eckler, STL).

Bacterial analysis of non-potable water for 2003 DWM samples will be performed using membrane filtration (SM9222D for fecal coliform and SM 9213D/EPA1103.1, modified MTEC method for E. col.i). The EPA-approved Hach m-ColiBlue24 method and media for E. coli bacteria may also be used.

12.2 Lab Instrument Use, Calibration and Maintenance

The calibration and maintenance procedures for each DWM lab analytical instrument are contained in ***Table 8***. For detailed descriptions of calibration and maintenance procedures for WES and STL-Westfield, see the respective lab QAPs and SOPs, adopted herein by reference (***Appendix F and Appendix G)***.

12.3 Standard Lab Protocols

See ***Appendix A*** for a summary of standard methods and procedures used at WES and STL-Westfield. Detailed WES and DWM SOPs are available on the 2003 QAPP CD and by request. Detailed SOPs for the STL-Westfield lab are also available (hard copy) on request to DWM.

12.4 Data Reporting

All lab-quality-controlled data will be sent directly to DWM's QA/QC Analyst for preliminary QC checks. Electronic (WES only) and hard copy (WES and STL-Westfield) data reports copies will also be sent to DWM's QC Analyst. See WES and STL-Westfield QAPs for specific lab protocols on data reporting. Also, sometime in 2003, it is anticipated that WES shall begin using their newly-revised LIMS system for all data reporting.

<u>Following preliminary DWM QC review for completeness and typographic-type errors, data can be released to the survey coordinators and others as "raw" data (QC status 1).</u>

12.5 Lab Data Qualifiers

The WES lab makes every effort to avoid the use of data qualifiers through sound lab practices, such as efficient sample tracking, expedient analysis and re-testing. In some instances, however, qualification of data is necessary and, in all cases, helpful when needed. As of 2/2003, WES may use the following data qualifiers for DWM 2003 analytes:

WES Lab Qualifiers:
"B" = Analyte found in reagant blank
"E" = Reported value exceeded calibration range
"J" = MDL < sample concentration < RDL (estimated value); sample lost (spillage, other…); certain QC criteria not met.
"PND" = Precision not determined
"R" = Sample results rejected; re-analysis warranted.
"U", "<MDL" or "<RDL" = Not detected

The Severn Trent lab may use similar qualifiers as needed for non-detected, problematic and estimated data (inorganic):

STL-Westfield Lab Qualifiers:
"B" = Analyte found in reagant blank
"E" = Reported value exceeded calibration range
"J" = MDL < sample concentration < RDL (estimated value); sample lost (spillage, other…); certain QC criteria not met.
"U", "<MDL" or "<RDL" = Not detected

Table 7. ***Analytical Services*** **[and DWM Sample Bottle Group] for 2003 DWM Watershed Monitoring Analytes**

Matrix (Bottle Group)	Analytical Parameter(s)	Analytical Method/ SOP reference	Approximate Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person(s) and Telephone Number)	Backup/Secondary Laboratory and Organization
Surface water (field)	Multi-probe parameters (DO, pH, specific conductance, temperature, % oxygen saturation and total dissolved solids (TDS) by calculation)	NA; in-situ Multi-probe (see CN 4.2 SOP)	Next day for draft fieldsheet data; approx. 3-6 months for validated final data	DWM Lab 627 Main Street, 2nd Floor Worcester, MA 01608 (508) 792-7470 Contacts: Jeff Smith, Richard Chase	None identified
Surface water [I]	Chlorophyll *a*	SM10200H and DWM SOP (CN 3.2)	Next day-3 days for draft data; approx. 3-6 months for validated final data	Same as above, except: Contacts: Joan Beskenis, Katie O'Brien	None identified
Surface water [R]	Apparent Color (lakes only)	SM2120B and DWM SOP (CN 2.1)	Next day-3 days for draft data; approx. 3-6 months for validated final data	Same as above, except: Contacts: Mark Mattson	None identified
Surface water [C/S]	Turbidity	SM2130B and DWM SOP (CN 95.0)	Next day-3 days for draft data; approx. 3-6 months for validated final data	Same as above, except: Contacts: Richard Chase, Jeff Smith	None identified
In-stream	Periphyton identification	DWM SOP (CN 60.0)	1-2 months for draft data; approx. 3-6 months for validated final data	Same as above, except: Contact: Joan Beskenis	None identified
In-stream	Benthic macroinvertebrate identification and analysis, and aquatic habitat assessment	DWM SOP CN 39.1 (benthics/habitat)	Approx. 6-9 months for validated final data (in final Tech Memos)	Same as above, except: Contacts: John Fiorentino, Bob Nuzzo	None identified
In-stream	Fish Population	DWM SOP CN 75.0 (fish population)	1-2 months for draft data; approx. 3-6 months for validated final data	Same as above, except: Contacts: Bob Maietta, Greg DeCesare	None identified
In-stream	Aquatic Macrophytes (lakes)	DWM SOP (CN 67.1)	1-2 months for draft data; approx. 3-6 months for validated final data	Same as above, except: Contacts: Mark Mattson, Greg DeCesare and Rick McVoy	None identified
Surface water [N]	Nutrients (TP, NH3-N; also), TKN, NO3-NO2-N and DRP)	*WES Lab SOPs*: TP, DRP=SM 4500-P-E NH3-N= EPA 350.1 TKN=EPA 351.2 NO3-N= EPA 353.1	30 days for draft data; approx. 3-6 months for validated final data	MADEP Division of Environmental Analysis, Senator William Wall Experiment Station (WES), 37 Shattuck Street Lawrence, MA 01843 (978) 682-5237 Contacts: Jim Sullivan, Oscar Pancorbo	None identified

Matrix (Bottle Group)	Analytical Parameter(s)	Analytical Method/ SOP reference	Approximate Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person(s) and Telephone Number)	Backup/Secondary Laboratory and Organization
Surface water [C]	Chemistry (Hardness, Alkalinity, Chloride, Turbidity)	*WES Lab SOPs*: Hard= SM2340B Alk= SM 2310B Chloride= SM4500Cl B Turb= SM2130B	30 days for draft data; approx. 3-6 months for validated final data	MADEP Division of Environmental Analysis, Senator William Wall Experiment Station (WES), 37 Shattuck Street Lawrence, MA 01843 (978) 682-5237 Contacts: Jim Sullivan, Oscar Pancorbo	None identified
Surface water [S]	TSS Turbidity	*WES Lab SOPs*: TSS= SM 2540 Turb= SM2130B	30 days for draft data; approx. 3-6 months for validated final data	Same as above	DWM Lab Worcester, MA Contact: Richard Chase
Surface water [D]	BOD-5; BOD-21 ("ultimate")	*WES Lab SOP*: BOD-5, 21= SM 5210	30 days for draft data; approx. 3-6 months for validated final data	Same as above	None identified
Surface water [B]	Fecal coliform (FC) *E. coli* (EC)	*WES Lab SOPs*: FC= SM 9222 D EC= SM9213D; EPA 1103.1	30 days for draft data; approx. 3-6 months for validated final data	Same as above, except: Contact: Ron Stoner	None identified
Fish tissue [PCB]	Polychlorinated biphenyls (arochlors and congenors) and organochlorine pesticides	*WES Lab SOP:* Modified AOAC 983.21 (multi-component)	90 days for draft data; approx. 6 months for validated final data	Same as above, except: Contact: Michael Bebirian	None identified
Fish tissue [M]	Heavy Metals (As, Cd, Pb, Se, Hg)	*WES Lab SOPs:* As, Se= EPA 200.9 Cd, Pb= EPA 200.7 Hg= EPA 245.6	90 days for draft data; approx. 6 months for validated final data	Same as above, except: Contact: Barbara Eddy	None identified
Surface water [B], [S]	Connecticut and Chicopee Watershed (only): Fecal coliform (FC) *E. coli* (EC) TSS Turbidity	*STL-Westfield Lab SOPs*: FC= SM 9222 D EC= SM9213D; EPA 1103.1 TSS= EPA 160.2 Turb= EPA 180.1	30 days for draft data; approx. 45 days for validated final data	Severn Trent Laboratories, Inc. (*tentative*) Westfield Executive Park 53 Southhampton Road Westfield, MA. 01085 Tel: 413-572-4000 FAX: 413-572-3707 **www.stl-inc.com** Contact: Mr. Steven Hartmann	MADEP DEAWall Experiment Station (WES), Lawrence, MA 01843 (978) 682-5237 Contact: Ron Stoner, Oscar Pancorbo

Table 8: DWM *Analytical Instruments* Calibration and Maintenance

Instrument	Person(s) Responsible	Frequency of Calibration	Inspection Activity and Frequency	Maintenance Activity and Frequency	Testing Activity and Frequency	Corrective Action (CA)	SOP Reference
DRT-15 CE Turbidimeter	Jeff Smith and Richard Chase	QC checks against 0.2, 10 and 40 NTU standards monthly and before each use	Inspect all cuvettes for cleanliness, scratces, etc. before each use; check batteries	As needed per SOP.	QC checks using DI water blanks and standards per SOP before each use.	Re-calibrate as necessary; note all unstable readings	CN 95.0
Turner TD-700 Fluorometer (Chl a analysis)	Joan Beskenis	Prior to and following the sampling season.	Calibration uses pure or re-hydrated Chlorophyll a preparations, or a solid standard	As needed per SOP.	Periodic QC checks using dehydrated Chl a during seasonal use.	Re-calibrate as necessary per SOP	CN 3.2
Hach color wheel (apparent color analysis)	Mark Mattson	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP	CN 128.0
Velocity Meters (for flow measurement) 1) Price AA 2) Teledyne-Gurley 3) Swoffer 4) Sontek ADV FlowTracker	Jeff Smith, Richard Chase and user	Before each use	Visual & Electronic; Before and after each use	Inspect post-use for damage; lubricate parts as needed per SOP. Also, repair and maintenance as needed.	Prior to each use in the lab; filed testing in Spring prior to seasonal use.	Re-calibrate as necessary. If repair and/or re-calibration ineffective, replace with alternate device.	CN 68.0

13.0 DATA QUALITY OBJECTIVES

Monitoring data for 2003 DWM watershed monitoring will meet the specific data quality objectives (DQOs) and measurement performance criteria outlined below. Not meeting these planned DQOs may subject project data to qualification or censoring during post-monitoring quality control review. For specific definitions of DQO terms, refer to the QAPP ***Glossary*** toward the end of this QAPP.

Note: The discussion below regarding laboratory accuracy and precision criteria shall also apply to the STL-Westfield Lab based on its 2002 Quality Manual.

13.1 Accuracy

Accuracy is determined by how close a reported result is to the true or expected value. For this project, laboratory accuracy criterion will be determined by following the policy and procedures provided in the WES laboratory's Quality Assurance Plan, generally using estimates of percent recoveries for known internal standards, matrix spikes and performance evaluation samples, and evaluation of blank contamination.

Specific accuracy objectives for this project are generally twofold, depending on the analyte range (e.g. +/- 0.010 mg/l @ < .05 mg/l and + /- 20% @ > .05 mg/l). Alternatively, accuracy criteria have been defined in terms of percent recovery percentages (e.g. 80-120 % recovery of matrix spike/PE sample).

Accuracy for Multi-Probe measurements will be assured through periodic maintenance of the unit and prior-to-use calibration using standard solutions and other checks (e.g. NIST-certified thermometer). Post-sampling checks of the unit will ensure the readings taken during the survey(s) were within QC acceptance limits for each Multi-Probe analyte.

13.2 Precision

Precision is a measure of the degree of agreement among repeated measurements and is estimated through sampling and analysis of replicate samples.

For this project, laboratory precision of lab duplicates will be determined by following the policy and procedures provided in the WES laboratory's Quality Assurance Plan and individual SOPs.

Overall precision objectives using relative percent difference (RPD) of field duplicate samples vary depending on the parameter and range from 10-25% RPD. Specific overall precision objectives for this project are twofold, depending on the analyte range (e.g. 0.010 mg/l @ < .05 mg/l; 20% @ > .05 mg/l).

For lake sampling only, precision of the Multi-Probe measurements will be determined by taking duplicate (via a second placement of the unit) readings at the same station location for a minimum of 1 station per trip or for 10% of sampling sites. Multi-Probe precision objectives will generally range from 5-10 % RPD depending on the parameter.

13.3 Representativeness

Representativeness refers to the extent to which measurements actually represent the true environmental condition. For this project, sampling stations have been selected to ensure that the samples taken represent typical field conditions at the time of sampling, and not anomalies due to site-specific conditions. In some cases, stations may have been sited to evaluate site-specific impacts (i.e. "hot spots").

13.4 Completeness

Completeness refers to the amount of valid data collected using a measurement system. It is expressed as a percentage of the number of valid measurements that should have been collected. For this monitoring, the completeness criterion is 80-100%. This assumes that, at most, one event out of five might be cancelled for some reason that could cause an incomplete data set with up to 20 % of the planned-on data not obtained.

13.5 Comparability

Comparability refers to the extent to which the data from this study is comparable to other studies conducted in the past or from other areas. For this monitoring, the use of standardized sampling and analytical methods, units of reporting, and site selection procedures are used to ensure comparability of data. Review of existing data and methods used to collect historical data have been reviewed and taken into account in the sampling design. Efforts to enhance data comparability have been made where appropriate.

13.6 Detection Limits

In general, the smallest amount of analyte that can be detected above signal noise and within certain confidence levels. Typically, Method Detection Limits (MDL) are calculated in the laboratory by analyzing a minimum of seven low-level standard solutions using a specific method. Detection limits in the traditional sense do not apply to some measurements such as pH and temperature that have essentially continuous scales. ***Table 9*** shows the MDLs (and RDLs, reporting detection limits) for each analyte, and for each lab. Also, refer to WES laboratory's Quality Assurance Plan for detailed information about MDL laboratory policy/procedures and individual analyte results. Range and (ideal) resolution specifications for the Multi-Probe are also shown in ***Table 9***.

13.7 Holding Times

Most analytes have standard holding times (maximum allowed time from collection to analysis) that have been established to ensure analytical accuracy. For this monitoring, each analyte holding time has been reviewed with respect to project logistics to ensure that they will be met. See Element 9, ***Table 2.***

13.8 Sensitivity

The ability of the method or instrument to discriminate between measurement responses. For this monitoring, refer to the WES laboratory's QAP, the Multi-Probe SOP (CN 4.2), the Chlorophyll a SOP (fluorometer use) and the SOP for DWM lab turbidity (CN95.0) .

13.9 Standard Protocols

See ***Appendix A*** for a summary of standard methods and procedures used at DWM, WES and STL-Westfield Labs. Detailed DWM and WES SOPs are available from DWM on the 2003 QAPP CD, and for STL-Westfield Labs by request.

13.10 Performance Auditing

13.10.1 **Field Audits**: Unscheduled field audits will be performed by the DWM QC Analyst to evaluate implementation of field methods, consistency with this QAPP and compliance with DWM SOPs. Field audits will attempt to evaluate at least one survey per watershed and, ideally, each survey crew member a minimum of one time over the monitoring period (this equates to evaluating field performance of approx. 15-20 persons).

13.10.2 **Lab Audits**: A one-time proficiency test of WES' analytical accuracy in determining nutrient (double-blind) and bacteria (single-blind) concentrations using DWM-prepared solutions and/or purchased QC check samples will be performed (in April-July). Bacteria samples will be sent to WES "single-blind" (quantity unknown, but identity as QC check sample known) and Nutrients "double blind" (both identity and quantity unknown) for analysis and reporting. Results will be compared to "true" values and evaluated against acceptance limit criteria. Results shall also be provided to WES for their information. The lab audit will be coordinated by and through DWM's QC Analyst. The results will be shared with the appropriate survey coordinator.

Similarly, STL-Westfield will be sent DWM-prepared solutions and/or purchased QC check samples in April-July to test quantitative proficiency of fecal coliform bacteria analysis. This audit will be coordinated by DWM's QC Analyst and bacteria audit samples will be provided by Microcheck, Inc. located in Northfield, Vermont. Results will be reported to Microcheck and a summary report from Microcheck, Inc. to the purchaser (DWM) will be produced.

Table 9. ***Data Quality Objectives*** **for 2003 DWM Monitoring (Multi-Probe Parameters, Water Quality Analytes, Fish Tissue Analytes, Continuous Temperature, Flow Estimates, Lake-Specific Analytes, and Benthic Macroinvertebrate, Habitat, Fish Community, Periphyton and Aquatic Plant Data)**

Analyte	Units	Expected Range	Project Quantification Limit, (QL)	Analytical Method MDL	Achievable Laboratory MDL	Laboratory RDL, if provided	Accuracy (+/-)	Overall Precision (RPD)	Resolution
Multi-Probe (Hydrolab® Series 3 and 4a; YSI 600XLM)									
Temperature	°C	0-30	NA	NA	NA	NA	0.15 (0.10)	5%	0.01 °C
Depth	meters	0-10	NA	NA	NA	NA	0.45 (0.3)	10%	0.1 m
pH	standard units	5-10	NA	NA	NA	NA	0.2	5%	0.01
Dissolved Oxygen	mg/L	0-12	NA	NA	NA	NA	0.2	5%	0.01 mg/L
Specific Conductance	µS/cm	50-500	NA	NA	NA	NA	1% of range	5%	4 digits
% Oxygen Saturation	%	0-110	NA	NA	NA	NA	NA	5%	NA
Turbidity	NTU	5-150	NA	NA	NA	NA	5% of range (2.6% of range)	10%	0.1 or 1 NTU
Water Quality, Flow, Macroinvertebrates, Habitat, Fish Community, Periphyton and Aquatic Plants									
Total Suspended Solids (TSS)	mg/L	0-250	1.0	Unknown	1.0	1.0 (WES); 1.0 (STL)	75-125% recovery of QC standard	1.0 or 25% RPD	NA
Total Phosphorus (TP)	mg/L	0-0.15	0.005	0.001-.0005	0.005	0.015	80-120% recovery of QC standard and lab-fortified matrix <50 ppb, 5 ppb >50 ppb, 10%	<50 ppb, 5 ppb >50 ppb, 10% RPD	NA
Dissolved Reactive Phosphorus (DRP)	mg/L	0-0.15	0.005	0.001-.0005	0.005	0.015	80-120% recovery of QC standard and lab-fortified matrix <50 ppb, 5 ppb >50 ppb, 10%	<50 ppb, 5 ppb >50 ppb, 10% RPD	NA
Ammonia Nitrogen (NH3-N)	mg/L	0-0.5	0.02	Unknown	0.02	0.06	80-120% recovery for QC standard and lab fortified matrix	0.01 or 20% RPD	NA
Nitrate-Nitrite-N (NO3-NO2-N)	mg/l	0-1	0.02	Unknown	0.02	0.06	80-120 % recovery for QC std. and lab fortified matrix	0.02 or 25% RPD	NA
Total Kjeldahl Nitrogen (TKN)	mg/l	0-1	0.10	Unknown	0.10	0.30	80-120 % recovery for QC std. and lab fortified matrix	0.02 or 25% RPD	NA
Turbidity, WES lab (DWM lab)	NTU	0-100	0.1	Unknown	0.10 (0.1)	0.2-0.5 WES & STL	80-120% recovery of QC standards (e.g. 0.2, 10, 40)	20% RPD	0.01
Apparent Color (lakes)	PCU	0-300	NA	Unknown	10	10	80-120% recovery of color standard <50, 10 PCU >50, 20%	<50, 10 PCU >50, 20% RPD	1 PCU

Analyte	Units	Expected Range	Project Quantification Limit, (QL)	Analytical Method MDL	Achievable Laboratory MDL	Laboratory RDL, if provided	Accuracy (+/-)	Overall Precision (RPD)	Resolution
Chlorophyll *a*	mg/m3	0-50	0.1	Unknown	0.1	0.1	75-125 % recovery for QC std.	2.0 or 20% RPD	0.1
Fecal coliform and *E. coli* bacteria	cfu/100 ml	0-5000	5 cfu/100 ml	Unknown	5 cfu/100 ml	5 cfu/100 ml (WES lab); 2 cfu/100 ml (STL lab)	"TNTC" on positive control and 0 or less than reporting limit for negative control	30% RPD for log 10 transformed duplicate data	NA
Alkalinity	mg/l as CaCO3	Neg.-200	2	Unknown	2.0	2.0	80-120 % recovery for QC std. and lab fortified matrix <20, 2 mg/l >20, 10 %	2.0 or 20% RPD	NA
Hardness	mg/l as CaCO3	0-100	Unknown	Unknown	0.66	2.0	80-120 % recovery for QC std. and lab fortified matrix for Ca and Mg (200.7 method)	15 %	NA
Chloride	mg/l	0-100	Unknown	Unknown	1.0	1.0	90-110 % recovery for QC std. and lab fortified matrix	15 %	NA
BOD-5 and 21 day "ultimate" BOD	mg/l	0-15	Unknown	Unknown	2.0	6.0	80-120 % recovery for QC std.	20% RPD	NA
Secchi disc (lakes)	meters	0-5 m	NA	NA	NA	NA	NA	10 %	0.1 m
Lake Morphometry	meters	0-100 m	NA	NA	NA	NA	See Lakes 2003 QAPP	See Lakes 2003 QAPP	See Lakes 2003 QAPP
Macrophyte Percent Cover (lakes)	0-100%	NA	NA	NA	NA	NA	NA (if true % cover were known, results would be expected to be +/- 20%)	NA	NA
Macrophyte Identification	NA	NA	NA	NA	NA	NA	Qualitative assessment by aquatic plant experts in DWM via spot checking/testing the accuracy of identification using the same plants.	Qualitative assessment based on same-plant identifications by other survey crewmembers.	NA
Habitat Assessment	NA	NA	NA	NA	NA	NA	NA	Qualitative evaluation based on duplicate assessment by other survey crewmembers.	NA

Analyte	Units	Expected Range	Project Quantification Limit, (QL)	Analytical Method MDL	Achievable Laboratory MDL	Laboratory RDL, if provided	Accuracy (+/-)	Overall Precision (RPD)	Resolution
Benthic Macroinvertebrates (taxonomy)	NA	NA	NA	NA	NA	NA	Qualitative assessment based on spot checks for taxonomic accuracy using the same samples, by separate DWM macroinvertebrate experts.	Qualitative assessment based on same-sample identification by other taxonomists in the group (John Fiorentino and Bob Nuzzo).	NA
Flow	cfs	0-500	NA	NA	NA	NA	15% (estimated)	10%	NA
Fish Population	NA	NA	NA	NA	NA	NA	Qualitative assessment, based on in-field or lab specimen verification by other trained/expert DWM fish taxonomists (for fish type/species).	Qualitative and/or quantitative assessment based on replicate analysis of an adjacent reach by the same DWM taxonomists.	NA
Fish Tissue Toxics									
-Length	centimeters	15-100	N/A	N/A	N/A	N/A	0.1	0.1	NA
-Weight	grams	80-4000	N/A	N/A	N/A	N/A	20	20	NA
-Age	years	1-10	N/A	N/A	N/A	N/A	+/- 1	+/-1	NA
-Fish fillets (composites)									
Arsenic	mg/kg wet	0-1	Unknown	Unknown	0.060	0.080	25%	30%	NA
Cadmium	mg/kg wet	0-1	Unknown	Unknown	0.08	0.24	25%	30%	NA
Lead	mg/kg wet	0-1	Unknown	Unknown	0.8	2.4	25%	30%	NA
Mercury	mg/kg wet	0-5	0.5	Unknown	0.010	0.030	25%	30%	NA
Selenium	mg/kg wet	0-1	Unknown	Unknown	0.060	0.080	25%	30%	NA
PCB Arochlor 1232	µg/g	0-5	1.0 (total)	Unknown	0.019	0.057	25%	30%	NA
PCB Arochlor 1242	µg/g	0-5	1.0 (total)	Unknown	0.019	0..057	25%	30%	NA
PCB Arochlor 1248	µg/g	0-5	1.0 (total)	Unknown	0.038	0..11	25%	30%	NA
PCB Arochlor 1254	µg/g	0-5	1.0 (total)	Unknown	0.013	0.039	25%	30%	NA
PCB Arochlor 1260	µg/g	0-5	1.0 (total)	Unknown	0.022	0.066	25%	30%	NA
Chlordane	µg/g	0-5	0.3	Unknown	0.046	0.14	25%	30%	NA
Toxaphene	µg/g	0-5	Unknown	Unknown	0.045	0.14	25%	30%	NA
a-BHC	µg/g	0-5	Unknown	Unknown	0.0054	0.016	25%	30%	NA
b-BHC	µg/g	0-5	Unknown	Unknown	0.0055	0.017	25%	30%	NA
Lindane	µg/g	0-5	Unknown	Unknown	0.0056	0.017	25%	30%	NA
d-BHC	µg/g	0-5	Unknown	Unknown	0.012	0.036	25%	30%	NA

Analyte	Units	Expected Range	Project Quantification Limit, (QL)	Analytical Method MDL	Achievable Laboratory MDL	Laboratory RDL, if provided	Accuracy (+/-)	Overall Precision (RPD)	Resolution
Hexachlorocyclopentadiene	µg/g	0-5	Unknown	Unknown	0.038	0.11	25%	30%	NA
Hexachlorobenzene	µg/g	0-5	Unknown	Unknown	0.018	0.054	25%	30%	NA
Trifluralin	µg/g	0-5	Unknown	Unknown	0.032	0.096	25%	30%	NA
Heptachlor	µg/g	0-5	0.3	Unknown	0.0078	0.023	25%	30%	NA
Heptachlor Epoxide	µg/g	0-5	Unknown	Unknown	0.0057	0.017	25%	30%	NA
Methoxychlor	µg/g	0-5	Unknown	Unknown	0.027	0.087	25%	30%	NA
DDD	µg/g	0-5	5.0 (total)	Unknown	0.0051	0.015	25%	30%	NA
DDE	µg/g	0-5	5.0 (total)	Unknown	0.0055	0.017	25%	30%	NA
DDT	µg/g	0-5	5.0 (total)	Unknown	0.0064	0.019	25%	30%	NA
Aldrin	µg/g	0-5	5.0 (total)	Unknown	0.0057	0.017	25%	30%	NA
PCB Congener BZ # 81	µg/g	0-0.02	Unknown	Unknown	0.001	0.003	25%	30%	NA
PCB Congener BZ # 77	µg/g	0-0.02	Unknown	Unknown	0.00078	0.0023	25%	30%	NA
PCB Congener BZ # 123	µg/g	0-0.02	Unknown	Unknown	0.0013	0.0039	25%	30%	NA
PCB Congener BZ # 118	µg/g	0-0.02	Unknown	Unknown	0.0012	0.0036	25%	30%	NA
PCB Congener BZ # 114	µg/g	0-0.02	Unknown	Unknown	0.0013	0.0039	25%	30%	NA
PCB Congener BZ # 105	µg/g	0-0.02	Unknown	Unknown	0.0013	0.0039	25%	30%	NA
PCB Congener BZ # 126	µg/g	0-0.02	Unknown	Unknown	0.001	0.003	25%	30%	NA
PCB Congener BZ # 167	µg/g	0-0.02	Unknown	Unknown	0.0012	0.0036	25%	30%	NA
PCB Congener BZ # 156	µg/g	0-0.02	Unknown	Unknown	0.0011	0.0033	25%	30%	NA
PCB Congener BZ # 157	µg/g	0-0.02	Unknown	Unknown	0.0012	0.0036	25%	30%	NA
PCB Congener BZ # 180	µg/g	0-0.02	Unknown	Unknown	0.0014	0.0042	25%	30%	NA
PCB Congener BZ # 169	µg/g	0-0.02	Unknown	Unknown	0.00059	0.0018	25%	30%	NA
PCB Congener BZ # 170	µg/g	0-0.02	Unknown	Unknown	0.0013	0.0039	25%	30%	NA
PCB Congener BZ # 189	µg/g	0-0.02	Unknown	Unknown	0.0013	0.0039	25%	30%	NA

Notes:

1) The analytes to be sampled for in 2003 are listed along with the DQOs, which are the reasonable goals for data quality. Accuracy and precision goals are based on potential error introduced via both field and lab activity. The analytical method limits are published in the analytical method and/or provided by the lab, as are the achievable laboratory limits. Multi-Probe information for accuracy and resolution is via manufacturer's specifications, and for precision is based on duplicate readings for lake sampling only.
2) "NA"= Not Applicable
3) "Unknown"= no information available or no DQO defined at this time.
4) PCB/pesticide MDL/RDL values are based on most recent analyses by WES (2001-02). Actual MDLs/RDLs may changes for 2003 analyses.

14.0 DATA ACQUISITION REQUIREMENTS (Non-Direct Measurements)

See Element 5 for each watershed for information pertaining to data collected, generated or procured from outside DWM prior to 2003, currently, as well as proposed for 2003-2004, for the Year 2 "pink" watersheds.

15.0 DATA MANAGEMENT AND DOCUMENTATION

15.1 DWM Data Management and Procedures

15.1.1 Field Sheets, Notebooks and COC Forms

All DWM field sheets, notebook pages and COC forms will be filed with the QC Analyst for preliminary review and hard copy filing. The majority of validated field data will be entered into the DWM database. These files are stored at the Worcester office and managed by DWM's Database Manager. Incomplete and/or erroneous field-recorded data and information will be brought to the attention of the appropriate field crew, coordinator and/or person(s). Any field notebook page(s) will be photocopied and added to the final hard copy file.

15.1.2 Receipt of Lab Data Reports

Laboratory-quality-controlled data from WES is sent electronically to the DWM QC Analyst (and Database Manager) for preliminary QC checks related to holding times and blank/duplicate frequencies. Laboratory-quality-controlled data from STL-Westfield (tentative) will be sent by hard copy to the DWM QC Analyst as soon as available per the Scope of Services for the contract (BRP-2003-01).

After preliminary QC checks, this data is available to users as QC Status 1 "raw" data, subject to additional quality control checks and evaluation. "Raw" data is for internal, departmental use only, and its use subject to management approval. After data validation has been completed, and typically within six months of receipt of lab data reports, the "FINAL" data (QC Status 4 and 5) is available in the database and in hard copy files for internal/external use.

15.1.3 DWM Document Tracking: "Control Numbers"

The DWM QC Analyst assigns document control numbers (CN) to all Quality Assurance Project Plans, SOPs, Assessment Reports and other important, internal documents. Assigning a control number ensures that the most current version is being used. A listing of all QAPP-, SOP- and Assessment Report-related documents is available in the QA/QC Document Control Number Logbook located in the QC Analyst's office and/or electronically in the Document Control Number Database. See ***Table 10*** for 2003 DWM monitoring documents and records.

15.1.4 Documentation Protocols

DWM logbooks, forms, data sheets, lab notebooks and chain-of- custody forms are formal laboratory records. Records should be made in indelible black ink or extra fine point permanent marker. There should be no omissions in the data. Erasing, "white-outs", removal of pages, and multiple crossovers are not used to correct errors. Corrections should be kept to a minimum by exercising caution when transcribing data.

When errors occur, they should be corrected according to the following procedures: 1) Draw a single line through the incorrect entry, insert the correct entry into the closest space available and initial and date the correction; 2) Groups of related errors on a single page should have one line through the entries and should be initialed and dated with a short comment supplied for the reason of data deletion.

15.1.5 DWM Databases

As of 2/2003, the DWM database system is composed of the following primary databases:

- Water Quality Data
- Benthic Macroinvertebrates
- Fish Contaminant Monitoring
- Toxicity Testing Data
- River Flow Data
- Herbicide Applications

- 303d list/TMDLs
- 305b Water body System

The majority of these are formatted via MS Access and are dynamically linked to the GIS. Other formats used include DbaseIII and Foxpro. Each database has specific uses, and the system is intended to allow fast, easy and standardized access to final data for various purposes.

DWM is currently working on a revised assessment database for 305(b)/303(d) reporting, and a newly-structured "monitoring database" for DWM internal data needs and for improved uploading to external databases, such as EPA's STORET.

15.1.6 DWM Data Qualifiers

In validating (see Element 19 for data validation procedures) and finalizing monitoring data, DWM uses the following data qualifiers, in addition to any lab qualifiers that may be used.

General Symbols (applicable to all types):

" ** " = Censored or missing data (i.e., data that should have been reported)
" -- " = No data (i.e., data not taken/not required)
" <mdl " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (eg. <0.2).

***Multi-probe-specific Qualifiers*:**

" i " = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses.

Qualification Criteria for Depth (i):

General Depth Criteria: Apply to each OWMID#

- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date

- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, ie. that all positive readings may be in error.)

" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" s " = field sheet recorded data were used to accept data, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.

" u " = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" c " = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" ? " = Light interference on Turbidity sensor (Multiprobe error message). Data is typically censored.

Sample-specific Qualifiers:

" a " = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" b " = blank Contamination in lab reagant blanks and/or field blank samples (indicating possible bias high and false positives).

" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" e " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" h " = holding time violation (usually indicating possible bias low)

" j " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the mdl.

" m " = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

" p " = samples not preserved per SOP or analytical method requirements.

" r " = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data.

15.2 WES and STL-Westfield Laboratory Data Management and Procedures

Refer to WES and STL-Westfield (tentative) Lab QAPs for specific information (***Appendix F and G***).

The WES lab submits data reports to DWM within 15-90 days after sample receipt, but this time range can expand greatly based on lab business and staffing constraints. In 2003, a new LIMS system at WES is being tested on real samples/data. This LIMS system will likely replace historical methods of data transmittal (hard copy, pdf e-files) by storing information and generating reports. With or without the LIMS, secondary data entry personel at WES is kept to a minimum to reduce the potential for typographic errors in reporting.

Data management at STL-Westfield (tentative) for 2003 DWM data shall be based on internal electronic files, and hard copy files and reports.

Table 10 2003 DWM Project Documentation and Records

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records
DWM Field Sheets	Multi-Probe Raw Data (Hard Copy & Electronic Copy)	Chain of Custody Forms	Data Validation Report for 2003 Data
Field Notebooks	DWM Field Sheets	Laboratory Raw Data Reports	QA/QC Watershed Appendices
Chain of Custody Forms	Multi-Probe Calibration Logbook	Electronic Laboratory Data (LIMS, lab databases)	Watershed Assessment Reports
	Multi-Probe Maintenance Logbook	Analytical Instrument Logbooks	Technical Memoranda (includes QA/QC summary)
	Multi-Probe User Reports	Laboratory QC Results	Technical Correspondences (i.e. e-mail)
		MDL Studies	Corrective Action Forms (CA)
		Reagent Water Logbook	
		Performance Evaluation Test Results	
		Turbidimeter Calibration Log	
		Accuracy Check Records for Continuous Temperature Loggers	

16.0 ASSESSMENT AND RESPONSE ACTIONS

16.1 Planned Assessments

Review of field activities for 2003 DWM monitoring is the joint responsibility of the Survey Coordinator for each watershed, the Monitoring Coordinator and the Quality Control Analyst. In addition, DWM's field audit process calls for the QC Analyst to accompany survey crews to evaluate adherance to SOPs and this QAPP by crews and individual crew members. Field audits attempt to evaluate at least one survey per watershed and, ideally, each survey crew member a minimum of one time. DWM sampling staff in need of performance improvements will be directed to re-read the relevant standard operating procedure and may be re-trained on-site during the evaluation. In addition, yearly field collection sampling reviews may be scheduled if modifications to sample procedures occur. If errors in sampling techniques are consistently identified, mandatory re-training will be scheduled.

In 2003, external laboratory audits of WES and STL-Westfield using quantitative QC check samples and Proficiency Test (PT) samples shall be performed by DWM for nutrients (TP, NH3-N) and bacteria (fecal coliform), respectively.

Assessment of raw laboratory data is mainly the responsibility of the WES and STL-Westfield labs (prior to data transmittal), and DWM's QC Analyst and Database Manager (upon receipt of raw, lab-validated data). The former involves level I and II reviews using the policy and procedures in each laboratory's Quality Assurance Plan (***Appendix F and G***). At DWM, the Quality Control Analyst and Database Manager review the data as part of initial QA/QC activity. Once the data pass initial review for any major flaws, the data are entered into the DWM database as "RAW" data ("QC Status 1"). Subsequent, additional QC review is performed to take data through "QC Status 2", "QC Status 3". This review is documented in an annual Data Validation Report (DVR) prepared by the QC Analyst. The DVR recommends data for qualification or censoring, based on criteria identified in the DWMs Data Validation SOP (CN 56.0, draft), and suggests corrective actions where necessary. Upon reaching "QC Status 4", the data is considered final and subject to unrestricted use. See Element 19 for a description of data status levels.

16.2 Corrective Action Responses

A Corrective Action Form must be submitted for all field and laboratory deviations and deficiencies that cannot be handled immediately. This form not only is the first step toward resolution, but also provides documentation of the problem. Refer to DWM's Corrective Action Procedures SOP (CN 5.0) for more information (MADEPc). An example completed form is provided in ***Appendix K***.

17.0 QUALITY ASSURANCE AND PROJECT REPORTING

The DWM Quality Control Analyst is responsible for ensuring that monitoring (sample collection and analysis) by DWM results in usable data. In addition to DWM's standard operating procedure documents and related QAPPs (MADEP 2003a, MADEP 2003b), this QAPP is the prime guidance document for 2003 DWM monitoring.

With respect to 2003 data, the DWM QC Analyst assists in training staff on proper field and laboratory procedures, serves as the main contact with WES and other labs, prepares and reviews QAPPs and SOPs as needed, and validates draft data for finalization. An annual Data Validation Report (DVR) for DWM's Year 2 monitoring is produced to finalize data. Assistance regarding data quality and other technical considerations is also provided by the QC Analyst to authors of watershed-specific Technical Memoranda for individual watersheds (Year 3 assessments).

The Assessment Coordinator and assessment staff at DWM are responsible for producing, reviewing and distributing the final watershed assessment reports. Final reports are forwarded to DEP regional offices, the Region 1 Environmental Protection Agency and other interested parties. At the time of first printing, eight (8) copies of each assessment report published by this office are submitted to the State Library at the State House in Boston; these copies are subsequently distributed as follows:

- On shelf; retained at the State Library (two copies)
- Microfilmed; retained at the State Library
- Delivered to the Boston Public Library at Copley Square
- Delivered to the Worcester Public Library
- Delivered to the Springfield Public Library
- Delivered to the University Library at UMass, Amherst
- Delivered to the Library of Congress in Washington, DC
- DEP web site: http://www.state.ma.us/dep/brp/wm/wqassess.htm

The TMDL Coordinator and TMDL staff are responsible for producing draft TMDL Implementation Plans for selected waterbodies in the 2003 Year-2 "pink" basins. Primary TMDL documents are available on the DEP web site (http://www.state.ma.us/dep/brp/wm/wqassess.htm), and upon request to Mark Mattson at DWM-Worcester.

Provisional draft data, final data and water quality assessment reports and TMDL evaluations can be obtained by contacting the MADEP, Division of Watershed Management at 627 Main Street, 2nd Floor, Worcester , MA 01608 (508) 792-7470.

18.0 DATA VERIFICATION AND VALIDATION REQUIREMENTS

Procedures used for data verification and validation for DWM watershed monitoring in 2003 will be generally consistent with Region 1, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses. The level of data validation will be similar to the "Tier II" type, as described in the Region 1, EPA- New England QAPP Guidance Compendium. Tier II specifically involves a thorough assessment of QC checks and samples and PE sample results. A Data Validation Report (DVR) will be produced.

Specific procedures for data validation are outlined in Element 19.0.

19.0 DATA VERIFICATION AND VALIDATION PROCEDURES

19.1 Data Validation Steps

A summary of data validation procedures to be applied to raw 2003 monitoring data are as follows. Additional information can also be found in the DWM Data Validation SOP (draft, CN 56.0). NOTE: If and when the WES LIMS operational network comes "on-line" and is used consistently, these steps may need to be revised accordingly.

1. Review hard-copy raw data fieldsheets (and field notebook data if available) for accuracy and potential problems; flag all "issues" for later follow-up.

2. Review hard-copy raw data COCs for accuracy and potential problems; flag all "issues".

3. Perform data entry into the WQD database for all applicable field- and lab data.

4. Check accuracy of all data entered into the WQD database ("data entry QC").

5. Evaluate field crew performance on specific surveys (and in general, as appropriate) based on the results of field audits; flag "issues".

6. Review hard copy DWM laboratory records (lab notebooks, lab bench sheets) for apparent color, chl a analysis, etc. were reviewed for potential effects on data quality and to the need for data qualification or censoring.

7. Review hard copy DWM (and that for other "agent" monitoring) Multi-probecalibration books for potential effects on data quality.

8. Review hard copy quality control results contained in the WES laboratory data reports for potential implications to data quality and to determine if any data was or should have been qualified by WES (based on lab accuracy and precision data).

9. Review hard copy WES laboratory data reports for potential problems, such as missing data, typos, missing pages, correct MDLs/RDLs, etc.

10. Evaluate WES (and other labs as appropriate) analytical performance during survey period based on results of QC/PE testing.

11. Review hard copy miscellaneous documentation (e-mails, phone records, pers. comms., etc.) to highlight any potential problems affecting data quality.

12. Review database report or hard copy for analytical holding time violations; flag/record in DVR.

13. Review database report for frequency of QC samples taken for each survey, and compare to DQO for blank and duplicate frequencies.

14. Review database report re: all Multi-probe data; produce draft qualify/censor decisions, flag data for follow-up, etc. (assumes that all downloading, reconciliation and post-processing of Multi-probedata has occurred).

15. Review database report re: Blank sample results; produce draft qualify/censor decisions, flag data for follow-up, etc.

16. Review database report re: Duplicate sample results; produce draft qualify/censor decisions, flag data for follow-up, etc.

17. Review available TMs for river/stream, lakes, benthic macroinvertebrates, fish toxics, and other "biological" data for potential issues affecting data quality; flag in annual DVR and follow-up as needed.

Draft copies of raw data (or provisional access to draft data) can be issued for project managers, survey coordinators or others with the required, appropriate caveats, such as:

> *"NOTE: This data is currently being validated by MADEP, Division of Watershed Management, and is considered DRAFT. As a result of DWM's data validation process, some of this data may be censored or qualified. Users of this data are cautioned to check with DWM for the latest available and final (published) data."*

19.2 Criteria for Censoring and Qualifying Data

Decisions to reject or qualify data are made collectively by the Assessment Coordinator, Database Manager, Survey Coordinator and the Quality Control Analyst, and are based on an examination and interpretation of the QA/QC analysis, DQOs, and other criteria, as outlined in DWM's Data Validation SOP (draft, CN 56.0).

Not meeting a specific DQO does not necessarily, in itself, invalidate data. Not meeting several DQOs, however, would likely result in data being censored. See Element 15.1.6 for data qualifiers used by DWM.

19.3 "QC Status" Levels for DWM Data

The following categories of "data readiness" are currently used at DWM, as it relates to the use and transmission of draft and final data. All DWM data are categorized into five levels, reflecting the status of review and validation (finalization). The preferred QC Status for use and/or release of DWM data is QC Status 5. Although not recommended, all levels (QC1-5) can be shared with others if requested (e.g. for Freedom of Information Act purposes) with the appropriate disclaimers based on the QC status of the data.

QC Status 1:
Raw data. Not suitable for use or transmission to other parties.

QC Status 2:
Draft data that has been entered into the appropriate DWM database and for which data entry QC has taken place. Not suitable for use or transmission to other parties, except with extreme caution and disclaimer (no technical or project-level review).

QC Status 3:
Draft data for which technical QA/QC review (e.g. QC sample results, outlier identification, comparison to project QAPP DQOs, etc.) has taken place. Not suitable for use or transmission to other parties, except with caution and disclaimer (no project-level review).

QC Status 4:
Final Data. This level of data reflects project-level review by appropriate staff for reasonableness, completeness and acceptability. This data can be freely used and cited in documents without caution or caveat.

QC Status 5:
Final data are presented in a published, citable report.

20.0 DATA USABILITY AND PROJECT EVALUATION

20.1 Data Usability

If certain data do not meet the program Data Quality Objectives (DQO's), data may be censored, qualified or left as draft subject to further review. Causes of aberrant data will be sought and evaluated as soon as possible, and corrective actions recommended. Any limitations on data use will be detailed in both interim and final reports and other documentation as needed.

Censored data will not become part of the permanent database, and will be reported as "censored data". Data flagged with qualifying language will become part of the database with appropriate denotation.

As soon as data is of known and documented quality (i.e. "QC Status 4" and "5") it can be used without caveats for analysis and decision making. As explained above, the extent to which data is determined to be useful is an on-going in-house evaluation based on issues such as confidence in the data, data conclusiveness, results of data analysis and the degree to which it is actually used appropriately by BRP/DEP/DWM staff and by others.

Final 2003 monitoring data will be made available in watershed-specific technical memoranda, which will include summary quality control evaluations. These memoranda shall support determinations made as part of the watershed assessment and TMDL development processes.

20.2 Project Evaluation

The success of 2003 monitoring will be evaluated on a continuous basis from QAPP finalization to data validation and use. The usefulness of the data for each watershed will be evaluated with regard to both programmatic and watershed-specific objectives. Final data will be used to answer important questions related to the current health of surface waters in the Commonwealth, as well as the potential for improvement in environmental quality.

GLOSSARY:

A common understanding of terminology is critical to an effective QA program. All project personnel should have the same working knowledge of these terms. The following terms are commonly-used in describing project QA/QC, from QAPP development to lab analysis and reporting. In most cases, these suggested definitions are entirely consistent with EPA guidance (1996).

PARCC Concepts:

Precision. A data quality indicator, precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions. Precision is usually expressed as a standard deviation in absolute or relative terms.

Accuracy. A data quality indicator, accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias.

Representativeness. A data quality indicator, representativeness is the degree to which data accurately and precisely portray the actual or true environmental condition measured.

Comparability. A data quality indicator, comparability is the degree to which different methods, data sets, and/or decisions agree or are similar.

Completeness. A data quality indicator that is generally expressed as a percentage, completeness is the amount of valid data obtained compared to the amount of data planned.

General QA/QC:

Analyte. Within a medium, such as water, an analyte is a property or substance to be measured. Examples of analytes would include pH, dissolved oxygen, bacteria, and heavy metals.

Bias. Often used as a data quality indicator, bias is the degree of systematic error or inaccuracy present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed in one direction. Bias should not be used interchangeably with accuracy.

Censored data: Data that has been found to be unacceptable as a result of the data validation process, including review for conformance to the approved QAPP and data quality objectives for the project (ex. required holding times for analysis, required frequency of field blanks and duplicates/splits, acceptability of precision estimates (standard deviation, SD or relative percent difference, RPD).

Chain-of-Custody: Used for routine sample control for regulatory and non-regulatory monitoring. The chain-of-custody form contains the following information: sample IDs, collection date/time/samplers, sample matrix, preservation reqts., delivery persons/date/time, etc… Used also as a general term to include sample labels, field logging, field sheets, lab receipt and assignment, disposal and all other aspects of sample handling from collection to ultimate analysis.

Data users. The group(s) that will be applying the data results for some purpose. Data users can include the principle investigators, as well as government agencies, schools, universities, watershed organizations, and business and community groups.

Data quality objectives (DQOs). Data quality objectives are quantitative and qualitative statements describing the degree of the data's acceptability or utility to the data user(s). They include indicators such as accuracy, precision, representativeness, comparability, and completeness (PARCC). DQOs specify the quality of the data needed in order to meet monitoring project goals.

Matrix. A matrix is a specific type of medium, such as surface water or sediment, in which the analyte of interest may be contained.

Measurement Range. The measurement range is the extent of reliable readings of an instrument or measuring device, as specified by the manufacturer.

Method Validation: Testing procedure for existing, new and modified methods, in which several evaluation steps are typically employed: determinations of MDL, method precision, method accuracy, and sensitivity to variation in method steps ("method ruggedness", SM, 1998).

Performance Audit: Unscheduled evaluation of field sampling QC or laboratory QC procedures by a third party not directly involved in the taking, transport and analysis of the samples; used to detect deviations from accepted SOPs. Audits can take many forms. Submittal of identical check samples to two different labs is an example of an external, blind performance audit. Lab intercomparison samples can also be used to test the lab's proficiency in relation to other labs. Results of audits are documented and any necessary corrections recommended.

Protocols. Protocols are detailed, written, standardized procedures for field and/or laboratory operations.

Quality assurance (QA). QA is an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. QA activities involve planning quality control, quality assessment, reporting, and quality improvement. These activities can be internal (within the main group) or external (involving outside parties).

Quality assurance project plan (QAPP). A QAPP is a formal written document describing the detailed quality control procedures that will be used to achieve a specific project's data quality requirements. A QAPP is a planning tool to ensure that project goals are achieved. Typically, QAPPs are finalized prior to monitoring activities and any deviations from the final QAPP made during the actual monitoring are noted in a subsequent task, such as the data reporting phase of the project. QAPPs can be of two main types:

> A "project-specific QAPP" provides a QA blueprint specific to one project or task and is considered the sampling and analysis plan/workplan for the project.
>
> A "generic program QAPP" is an overview-type plan that describes program data quality objectives, and documents the comprehensive set of sampling, analysis, QA/QC, data validation and assessment SOPs specific to the program. An example is a macroinvertebrate monitoring program performed throughout many watersheds within a State.

Quality control (QC). QC is the overall system of technical activities designed to measure quality and limit error in a product or service. A QC program manages quality so that data meets the needs of the user as expressed in a quality assurance project plan. Specific quality control samples include blanks, check samples, matrix spikes and replicates.

Random Sample: A sample chosen such that the choice of each event in the sample is left entirely to chance; an unbiased sample generally representative of the population. Randomness is a property of a sample that must exist for almost any statistical test, but may not be appropriate for all sampling designs (ex. Non-random site selection based on targeting specific conditions or based on practical considerations).

Relative standard deviation (RSD). A measure of precision calculated by dividing the std. deviation by the mean, expressed as a percentage. Used when sample number exceeds two.

Relative percent difference (RPD). A measure of precision used for duplicate sample results. It is calculated by dividing the difference between the two results by the mean of the two results, expressed as a percentage. Used when sample number equals two.

Sensitivity. Similar to resolution, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses.

Standard deviation(s). Used in the determination of precision, standard deviation is the most common calculation used to measure the range of variation among repeated measurements. The standard deviation of a set of measurements is expressed by the positive square root of the variance of the measurements.

Standard operating procedures (SOPs). An SOP is a written, official document detailing the prescribed and established methods used for performing project operations, analyses, or actions. Each DWM SOP is reviewed and approved for accuracy and applicability by DWM managers.

Trend: Systematic tendency over time in a specific direction in time series data, ideally collected at uniform intervals, collected and analyzed using the same (or comparable) methods and containing no gaps in periodic data.

True value. In the determination of accuracy, observed measurement values are often compared to true, or standard, values. A true value is one that has been sufficiently well established to be used for the calibration of instruments, evaluation of assessment methods or the assignment of values to materials.

Variance. A statistical term used in the calculation of standard deviation, variance is the sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the numbers in the set.

Field Quality Control:

Duplicate sample. Used for quality control purposes, field/lab duplicate samples are two samples taken generally at the same time from, and representative of, the same site/sample that are carried through all assessment and analytical procedures in an identical manner. Field duplicate samples are used to measure natural variability as well as the precision of field sampling and lab analytical methods. Lab duplicates are used as a measure of method precision. More than two duplicate samples are referred to as replicate samples.

DWM field blank water: Deionized water made available by properly-maintained and -functioning water filtration system located in DWM laboratory.

Environmental sample. An environmental sample is a specimen of any material collected from an environmental source, such as water or macroinvertebrates collected from a stream, lake, or estuary.

Field blank. A field blank is created by filling a clean sample bottle with deionized or distilled water in the field during sampling activities. The sample is treated the same as other samples taken from the field. Field blanks are submitted to the lab along with all other samples and are used to detect any contaminants that may be introduced during sample collection, fixing, storage, analysis, and transport.

Field composite sample: A sample taken by mixing equal volumes of a pre-determined number of grab samples from the same location at different times, ie. a time-composite. Used to assess average conditions present between the first and last grab samples that are composited. Use time-composite sampling only for those parameters that can be shown to remain unchanged under the specific conditions of composite sample collection. Flow-weighted composite sampling is a variation to time-composite sampling, in which sample volume adjustments are made to each grab based on variations in flow, such as occurs during stormwater monitoring loading studies.

Field integrated sample: A sample taken by simultaneously combining a matrix across vertical or horizontal strata as an evaluation of average composition within the boundaries of the integration (ex. Photic zone sampling for chlorophyll a). Sampling tubes can sample continuous, integrated media.

Field Split: A second sample generated from the same sampling location and at the same time by splitting a large volume sample from one sampler deployment into two equal volume samples. Used to measure precision, except that associated with actual sample collection, and excludes natural variability. Also referred to as duplicate subsample.

Field Duplicate (sequential): A second sample generated from the same sampling location as the initial sample, but from a second sampler deployment immediately after the first. Used to measure overall field sampling precision and includes an unknown amount of natural variability (spatial and temporal), if present.

Field Duplicate (simultaneous): A second sample generated from the same sampling location and at the same exact time as the other sample by simultaneous deployment of two identical sampling devices or by the simultaneous filling of two separate sample bottles. Used to measure overall field sampling precision and includes an unknown amount of natural variability (spatial), if present. Also referred to as a co-located duplicate.

Grab Sample: A manually collected sample at a specific location and time. Given practical constraints and budget limitations, assumptions are usually made that the natural variation is small enough over space/time to consider the grab to be representative of conditions over a greater expanse and/or longer period. In some cases, these assumptions may not always be valid.

Laboratory Quality Control:

Blind sample. a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the analyst's or laboratory's expertise in performing the sample analysis.

Calibration Blank. Reagent-grade, purified water (deionized/distilled) used as a zero standard; used to "zero" lab instruments, evaluate instrument drift and check for sample contamination of field blanks.

Calibration Check Standard: A standard used to check the calibration of an instrument between periodic recalibrations.

Detection limits. Applied to both methods and equipment, detection limits are descriptions of the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain as greater than zero. Specific detection limits include: Instrument detection limit, level of quantitation, lower level of detection, method detection limit, practical quantitation limit and reporting detection limit.

Instrument detection limit (IDL) The concentration that produces a signal greater than five times the signal/noise ratio of the instrument.

Level of Quantitation (LOQ): The concentration that produces a signal sufficiently greater than the blank that it can be detected; typ. The concentration that produces a signal 10*s above the blank signal. Typically, ten times the IDL (SM, 1998) .

Lower level of detection (LLD): Measurement level reproducible with 99% certainty; typically twice the IDL.

Method detection limit (MDL). The MDL is the concentration that produces a signal with a 99% probability that it is different from the blank, after going through the entire method. The smallest amount that can be detected above the noise in a procedure and within a stated confidence level. Typically, four times the IDL.

Practical Quantitation Limit (PQL). The lowest concentration level that several labs can report using the same method and samples; typically, ten times the IDL, and 3-5 times the MDL.

Reporting Detection Limit (RDL). The lower limit that the lab feels comfortable reporting with a high level of certainty. For practical purposes, the RDL is often equivalent to the MDL.

Equipment or rinsate blank. Used for quality control purposes, equipment or rinsate blanks are types of field blanks used to check specifically for carryover contamination from reuse of the same sampling equipment (see field blank).

Lab Split: A sample that has been divided into two or more subsamples. Splits are submitted to different analysts or laboratories and are used to measure the precision of the analytical methods. Lab splits are an external QC protocol.

Lab duplicate: A sample that has been divided into two or more subsamples. It is processed concurrently and identically with the initial sample by the same laboratory. It is used to measure the precision of the analytical methods. Lab duplicates are also referred to as lab splits.

Method Blank: An aliquot of clean reference matrix carried through the analytical process to assess the degree of laboratory contamination and indicate accuracy.

Matrix Spike: A sample to which a known concentration of target analyte has been added. When analyzed, the difference in analyte concentration between a spiked sample and the non-spiked sample should be equivalent to the amount added to the spiked sample. Lab QC sample used to assess sample matrix effects on recovery of target analyte and evaluate accuracy. Also known as Lab-fortified matrix. Duplication of this sample is referred to as matrix spike duplicate or lab-fortified matrix duplicate.

Performance evaluation (PE) samples. A sample of known concentration submitted "blind" (without lab's knowledge) to the analyst. PE samples are provided to evaluate the ability of the analyst or laboratory to produce analytical results within specified limits, and as an indicator of method accuracy. Also called a laboratory control sample.

Spike Blank: Known concentration of target analyte(s) introduced to clean reference matrix and processed through the entire analytical procedure; used as an indicator of method performance and accuracy. Also known as Lab-fortified blank.

Standard reference materials (SRM). An SRM is a certified material or substance with an established, known and accepted value for the analyte or property of interest. Employed in the determination of bias, SRMs are used as a gauge to correctly calibrate instruments or assess measurement methods. SRMs are produced by the U. S. National Institute of Standards and Technology (NIST) and characterized for absolute content independent of any analytical method.

Qualifier: Used to indicate additional information about the data, and generally denoted as capital letters in data reports. Qualifier acronyms or terms are unique to each laboratory.

Quality Assurance Plan (QAP): A comprehensive laboratory document detailing lab quality control procedures (eg. WES QAP).

WES Lab SOP Manual: A collection of analyte-specific laboratory standard operating procedures (SOPs) used for analysis of samples. As of 1/2001, this "manual" is composed of separate, individual SOPs for selected analytes (not a bound, complete manual). Some SOPs used at WES are currently undocumented as formal SOPs.

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<u>APPENDICES</u>:

A. Summary of Policies, Guidelines and Standard Operating Procedures for 2003 Monitoring

B. 2003 Baseline Lakes Monitoring QAPP (by reference)

C. 2003 Benthic Macroinvertebrate Monitoring QAPP (by reference) ***(subject to revision)***

D. Fish Toxics Programmatic QAPP (by reference) ***(subject to revision)***

E. CERO "SMART" Monitoring Program QAPP

F. WES Quality Assurance Plan and SOPs (by reference)

G. Severn Trent Laboratories Quality Assurance Plan and SOPs (by reference)

H. 2003 Schedule for Sample Delivery to WES/STL-Westfield

I. 2003 DWM Fieldsheets, Checklists, Labels and Sample Chain-of-Custody Forms (examples)

J. Lab Data Reporting Format (examples)

K. DWM Corrective Action Initiation Form

L. Potential Non-Year-2 Fish Toxics Monitoring Stations ***(subject to revision)***

APPENDIX A

Summary of Policies, Guidance and Standard Operating Procedures for 2003 Watershed Monitoring

APPENDIX A: Summary of Policies, Guidance and Standard Operating Procedures for 2003 Monitoring

For copies or information related to one or more DWM SOPs, contact Richard Chase, DWM QA/QC Analyst. Within DWM-Worcester, most of these documents can be found at ***w/dwm/sop***. **Bold CNs are new and/or newly-revised for 2003.**

Policy/Guidance/Procedure	Document Control Number (CN)	Last Revised Date	Primary Author(s) and/or Contact(s)
Station DefinitionGuidelines	**CN 0.6**	2/2003	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
DWM Data Submittal Requirements	**CN 0.7**	3/2003	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
DWM Data Use Guidance (draft)	**CN 0.8**	3/2003	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
Sample Collection Techniques for DWM Monitoring	**CN 1.3**	3/2003	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
Apparent Color SOP	CN 2.1	9/2001	Mark Mattson, DWM (508) 767-2858
SOP for Chlorophyll Sampling and Analysis	CN 3.2	6/2001	Joan Beskenis, DWM (508) 767-2794
SOP for Multiprobe Use	**CN 4.2**	3/2003	Jeff Smith, DWM ; (508) 767-2858
SOP for Corrective Action Procedures	CN 5.0	5/2000	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
DWM QAPP Official Format	CN 6.0	1/2001	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
SOP for Field /Lab Safety	CN 8.0	1/2001	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
DWM SOP Official Format	CN 10.0	1/2001	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
CERO-"SMART" Monitoring Program QAPP	**CN 12.1**	3/2003	Therese Beaudoin, MADEP, CERO; 508- 792-7650
SOP for In-Stream Benthic Macroinvertebrate Monitoring	CN 39.1	7/2002	Robert Nuzzo, DWM (508) 767-2792 John Fiorentino, DWM (508) 767-2862
SOP for Fish Toxics Monitoring	CN 40.1	10/2001	Robert Maietta, DWM (508) 767-2793
SOP for Secchi disc	CN 55.0	8/2000	Mark Mattson, DWM (508) 767-2858 Richard Chase, DWM QA/QC Analyst; (508) 767-2859

Policy/Guidance/Procedure	Document Control Number (CN)	Last Revised Date	Primary Author(s) and/or Contact(s)
DWM Data Validation SOP (draft)	CN 56.0, 56.1	11/2002	Richard Chase, DWM QA/QC Analyst; (508) 767-2859
SOP for Field Equipment Washing	CN 59.0	7/2002	Mark Mattson, DWM (508) 767-2858 Richard Chase, DWM QA/QC Analyst; (508) 767-2859
SOP for Periphyton Sampling and Analysis	CN 60.0	4/2002	Joan Beskenis, DWM ; (508) 767-2794
DWM Laboratory SOP	CN 66.0	4/2001	Richard Chase, DWM QA/QC Analyst; (508) 767
Lake Macrophyte Mapping SOP	**CN 67.1**	8/2002	Mark Mattson, DWM (508) 767-2858
Flow Measurement SOP	**CN 68.0, 68.1**	3/2003	Richard Chase, DWM QA/QC Analyst; (508) 767
Fish Population Monitoring SOP	CN 75.0	8/2002	Robert Maietta, DWM (508) 767-2793 Richard Chase, DWM QA/QC Analyst; (508) 767
Bathymetric Maps SOP	**CN 82.0**	2/2003	Mark Mattson, DWM (508) 767-2858
Turrbidity Analysis SOP	**CN 95.0, 95.1**	3/2003	Richard Chase, DWM QA/QC Analyst; (508) 767
SOP for Continuous Temperature Monitoring	**CN 103.0**	2/2003	Richard Chase, DWM QA/QC Analyst; (508) 767
WES Lab Quality Assurance Plan	---	2002	Oscar Pancorbo, WES Lab; (978) 682-5237
WES Lab SOP for TP/DRP analysis (SM 4500-P E)	---	1/2001	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for Alkalinity (SM 2320 B)	---	4/1999	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for Solids (SM 2540)	---	2000	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for TKN (EPA 351.2)	---	2000	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for NH3-N (EPA 350.1)	---	2001	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for NO3-NO2-N (SM 4500; EPA 353.1)	---	2001	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for Hardness (SM2340B; EPA 130.2)	---	2002	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for Chloride (SM 4500 Cl B)	---	2001	Jim Sullivan, WES Lab; (978) 682-5237

Policy/Guidance/Procedure	Document Control Number (CN)	Last Revised Date	Primary Author(s) and/or Contact(s)
WES Lab SOP for BOD-5 day/21 day (SM 5210B;EPA 405.1)	---	2001	Jim Sullivan, WES Lab; (978) 682-5237
WES Lab SOP for Microtox (AZUR Enviro. Co.)	---	2001	Ron Stoner, WES Lab; (978) 682-5237
WES SOP for Determination of Metals (USEPA Method 200.7, 200.9, 245.1)	---	200.7: 12/2001 200.9: 2/2002 245.1: 12/2001	Barbara Eddy, WES Lab; (978) 682-5237
WES Lab SOP for PCBs in Fish (AOAC 983.21)	---	2002	Mike Bebirian, WES Lab; (978) 682-5237
WES Lab SOP for Pesticides in Fish	---	2002	Mike Bebirian, WES Lab; (978) 682
WES Lab SOP for Organics in Fish (SM 5520)	---	2002	Mike Bebirian, WES Lab; (978) 682
WES Lab SOP for Fecal Coliform (SM 9222D)	---	2002	Ron Stoner, WES Lab; (978) 682-5237
WES Lab SOP for Enterococci (EPA 1600)	---	2002	Ron Stoner, WES Lab; (978) 682-5237
WES Lab SOP for E. coli bacteria (EPA 1103.1 modified m-TEC)	---	2002	Ron Stoner, WES Lab; (978) 682-5237
Severn Trent Laboratories (STL-Westfield) (*tentative*) Lab Quality Manual	---	9/2002	Severn Trent Laboratories, Inc. (*tentative*) Westfield Executive Park, 53 Southhampton Road Westfield, MA. 01085 Tel: 413-572-4000; FAX: 413-572-3707 **www.stl-inc.com** **Contact: Mr. Steven Hartmann**
STL SOP for E.coli by membrane filtration (SOP ID: BIS00701.MA)	---	1/2002	Same as above
STL SOP for fecal coliform by membrane filtration (SOP ID: BIS01100.MA)	---	2/2003	Same as above
STL SOP for TSS (SOP ID: INS00202.MA)	---	11/2001	Same as above
STL SOP for Turbidity (SOP ID: INS00101.MA)	---	10/1999	Same as above

APPENDIX B

2003 Lakes Monitoring QAPP (CN 128.0)

(included by reference; complete Lakes QAPP available on CD version and at **w/dwm/sop/CN 128.0**)

The following basin-specific Phosphorus Loading Study descriptions are included in the respective Element 5-8 sections of this QAPP:

1) Quaboag and Quacumquasit Ponds Phosphorus Loading Study (Chicopee)
2) Harris and Spindleville Ponds Phosphorus Loading Study (Blackstone)

APPENDIX C

2003 Benthic Macroinvertebrate Monitoring QAPP

(included by reference; complete QAPP available on CD version and at **w/dwm/sop/CN 147.0**)

Note: The 2003 benthic macroinvertebrate and aquatic habitat monitoring level of effort may be significantly reduced, based on resource limitations and practical concerns (see Executive Summary)

APPENDIX D

Fish Toxics Programmatic QAPP (CN 096.0)

(by reference; see **w/dwm/sop/cn96.0**)

Note: The 2003 fish toxics monitoring level of effort may be significantly reduced, based on resource limitations and practical concerns (see Executive Summary)

APPENDIX E

MADEP CERO "SMART" Monitoring Program QAPP (CN 012.1)

(by reference; see **w/dwm/**sop/cn12.1)

This QAPP details annual monitoring conducted by the MADEP, Central Regional Office in the Concord, Blackstone, Nashua, Millers, Chicopee and French/Quinebaug Watersheds.

Note: As of 3/2002, finalization of this QAPP is still pending.

APPENDIX F

WES Laboratory Quality Assurance Plan and SOPs

(included by reference; available on the 2003 QAPP CD; or by request to Richard Chase, DWM)

APPENDIX G

Severn Trent Laboratories Laboratory Quality Assurance Plan and SOPs

(included by reference; see Richard Chase, DWM for additional information)

APPENDIX H

2003 Schedule for Sample Delivery to WES and STL-Westfield Labs

(available as EXCEL sheet on CD version only, and by request)

APPENDIX I

2003 DWM Fieldsheets, Checklists, Labels and Sample Chain-of-Custody Forms

Documentation to be used in 2003 for field notes, bottle labels, sample tracking, etc. include:

1) Field Survey Checklist
2) Field Kit and Flow Measurement Kit Items List
3) Multi-probe User Report Form (and example)
4) Sample Labels (Examples)
5) River Survey Fieldsheet (Example)
6) Lakes Survey Fieldsheet (Example)
7) WES and STL-Westfield Lab Sample Chain-of-Custody Forms (and Examples)
8) DWM Habitat Survey scoring sheet

Field Survey Checklist

Note: Use as a guide to review what you need to take; "standard" items are generally REQUIRED)

STANDARD (rivers, lakes)		**OPTIONAL**	
Complete Field Kit (see Items List)		Flow Measurement Kit (see Items List)	
Complete Field First Aid Kit		Ponar sediment sampler	
Emergency phone numbers		Machete/weed cutter	
Multiprobe with data recorder		Cellular phone	
Spare battery for Multi-probe		Site-specific location maps	
Vehicle book		Project QAPP/SOPs as needed	
Field Notebook			
DWM Fieldsheet(s)		5 gal. Bucket for biological samples, misc….	
WES/____________ C.O.C. Forms		Auxillary tool kit	
Sample bottle labels			
DWM OWMID numbers			
Sampling basket (inc. sand-filled bottles and weights)			
Van Dorn/Kemmerer sampler (if needed; lakes)			
Required sample bottle number and size(s), including those for blanks and duplicate QC samples			
Cooler(s) with thermometers			
Ice for cooler(s)			
Acid preservation kit (1:1 H_2SO_4 with pipettes in plastic zip-lock bag)			
Depth sounding device			
Secchi disc			
Viewscope (Secchi)			
Boat, motor, gas, oars, oarlocks, rope, anchor, etc. as approp.…			
Personal flotation device(s): 1 for each boat occupant			
Weighted hose sampler (Chl a)			
Metal clipboard			
Camera and film (high resolution digital preferred)			
Field umbrella			
Safety vests (one for each monitor)			
Personal rain gear, sunglasses and hat			
Waterproof boots (length as approp.)			
Emergency rations and drinking water			

Field Survey Kit Items:	√
<u>Standard:</u>	
Extra markers (Sharpie, pen, pencil)	√
Rubber bands	√
Rubber gloves	√
Plastic sampling gloves (several pairs)	√
Tape measure	√
Flashlight	√
Sunscreen	√
Insect repellent	√
Bacteriocide lotion	√
Poison ivy/oak wash lotion	√
Foot ruler	√
CPR face mask	√
Safety glasses (1 pair)	√
pH strips	√
Electrical tape	√
	√
Screwdriver	√
<u>Optional: (not included as standard)</u>	
Compass	
Moist towelettes/paper towels	
State map	
Flow Measurement Kit Items: **in addition to field survey/kit items above**	
Tape pins (4-6)	
Tape Measure/Tag line (2)	
Flow meter (Price AA, Swoffer or Sontek ADV as appropriate)	
Rickly counter/Swoffer indicator/Sontek data recorder (as appropriate)	
Pens/pencils	
Flow fieldsheets	
Staff gages (as needed)	
Stopwatch	

MULTI-PROBE PRE-CAL CHECKLIST & USER REPORT

(Please review Checklist prior to survey departure and complete/return User Report when returning Multi-probe to DWM .)

MULTI-PROBE PRE-CAL CHECKLIST

Project/Basin________________ Monitoring Coordinator ________________________

Sent Items:

☐ SONDE	☐ SRV3	☐ STIRRER
☐ CHECK STD	☐ STRAPS	☐ LINKS
☐ FIELD GUIDE	☐ FIELD SHEETS	☐ CLEAN RAG
☐ CASE	☐ CABLE	☐ AUX. BATT.
☐ ANCHOR/ROPE	☐ OTHER _____________________________	

Date/Time__________________ Multi-probe Calibrator (initials) ________

USER REPORT

Monitoring Coordinator _____________________ User Name_____________________

Returned Items:

☐ SONDE	☐ SRV3	☐ STIRRER
☐ CHECK STD	☐ STRAPS	☐ LINKS
☐ FIELD GUIDE	☐ FIELD SHEETS	☐ DIRTY RAG
☐ CASE	☐ CABLE	☐ AUX. BATT.
☐ ANCHOR/ROPE	☐ OTHER _____________________________	

User Observations:

□ Sonde/sensor(s) malfunctioned _____
damaged _____
□ Bubbles observed under DO membrane
□ Stirrer spinning inconsistent
□ Case damaged
□ Data logger battery failed ____
malfunctioned ____
□ Readings could not stabilize for pH____ DO____ %Sat.____ Sp.Cond./Sal.____ Temp._____
Depth_____ Turbidity_____
□ Cable damaged _____
malfunctioned _____
Other:____

____

____

____

____

Date/Time__________________ User (initials) _______

MULTI-PROBE PRE-CAL CHECKLIST & USER REPORT

(Please review Checklist prior to survey departure and complete/return User Report when returning Multi-probe to DWM.)

MULTI-PROBE PRE-CAL CHECKLIST

Project/Basin Nashua (SMART) **Monitoring Coordinator** T. Beaudoin

Sent Items:

- ☒ SONDE # 15559 — ☒ SRV3 # 24572 — ☒ STIRRER # 15555
- ☒ CHECK STD — ☒ STRAPS — ☒ LINKS
- ☒ FIELD GUIDE — ☒ FIELD SHEETS — ☒ CLEAN RAG
- ☒ CASE — ☒ CABLE 25 m — ☒ AUX. BATT. # 4
- ☐ ANCHOR/ROPE — ☒ OTHER extra rags

Date/Time 2/5/03 7:21 **Multi-probe Calibrator (initials)** J.S.

USER REPORT

Monitoring Coordinator T. Beaudoin **User Name** T. Beaudoin

Returned Items:

- ☒ SONDE — ☒ SRV3 — ☒ STIRRER
- ☒ CHECK STD — ☒ STRAPS — ☒ LINKS
- ☒ FIELD GUIDE — ☒ FIELD SHEETS — ☒ DIRTY RAG
- ☒ CASE — ☒ CABLE — ☒ AUX. BATT.
- ☐ ANCHOR/ROPE — ☐ OTHER ________

User Observations:

- ☐ Sonde/sensor(s) malfunctioned ____ damaged ____
- ☐ Bubbles observed under DO membrane
- ☒ Stirrer spinning inconsistent —— Station NR01 only.
- ☐ Case damaged
- ☐ Data logger battery failed ____ malfunctioned ____
- ☒ Readings could not stabilize for pH____ DO____ %Sat.____ Sp.Cond./Sal.____ Temp.____ Depth____ Turbidity ✓ (most stations)
- ☐ Cable damaged ____ malfunctioned ____

Other: Depth re-cal. performed at each station.

Date/Time 2/5/03 15:05 **User (initials)** TMB.

CN 127.0 QAPP for 2003 DWM Monitoring in the Blackstone, Chicopee, Connecticut and Nashua Watersheds
W/dwm/sop/cn 127.0
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PROJECT SAMPLE LABELS (*Examples)*

12-KC01	11
August 1997 Kinderhook Creek dnst. fr. Brodie Mountain Road, Hancock, MA coll. R. Nuzzo	

Example of label to be placed in containers with benthos samples.

12-KC01	11 August 1997
Philopotamidae	

Example of label to be placed in benthos specimen vials after sorting.

12-KC01	11 August 1997
Kinderhook Creek dnst. fr. Brodie Mountain Road, Hancock, MA Chimarra sp.	
	det. R. Nuzzo

Example side label for benthos (orient the head with its ventral surface facing up).

Massachusetts DEP Wall Experiment Station Sample Field No.__________ Sample Lab No.___________

Example of label to be placed on WQ bottles.

Massachusetts Department of Environmental Protection/Division of Watershed Management
Rivers and Streams Field Sheet

Rivers and Streams
Station Sheet 1 of 3

Survey Lead (initial) RC
General Information (fill out prior to departure)

Project: Year 2 Blackstone
SARIS #: 5131800
River: WEST River
Town: Uxbridge
Station ID #: WR08

General weather conditions last 3 days at: Worcester http://lgov5.mes.mass.gov/ev/...

date:	SkyC:	WxType:	Tpcpn:
8/6/03	2.1	—	1.00
8/5/03	1.4	F	0.00
8/4/03	0.7	F	0.00

Sampling Crew (full names (last name is OK for year round DWM employees))
Lead: R. Chase Others: T. Brown

Station Information (fill out at station, DETERMINE LEFT/RIGHT BANK BY LOOKING *DOWNSTREAM*)

Date 8/7/03 Local Time (24 hr.) 9:45 am ✓ pm ___ Photos taken? ✓yes □ no If @ Bridge: ✓upstream, OR □ downstream

Description of Station Access (include posted signs, paths, etc. and riparian condition [canopy cover, artificial banks, vegetation types, etc.]): Wade in via path on left bank (near stop sign) Tree cover ½ width of river

Station Description (describe consistently using DWM station file descriptions. If typed here, confirm accuracy by checking box □, OR EDIT): East Avenue / Smith St. bridge

Staff gage reading and source/type (if available) N/A

Estimated water velocity □ none (0 fps) ✓low (0-1 fps) □ medium (1-5 fps) □ high (>5 fps)

Current Weather	Air Temperature (°F)	Wind Conditions	Odor	Water Clarity (check most applicable, based on visual exam in clear container)	Water Color (use clear container)
□ Clear	□ <20	□ Calm (0-1 mph)	✓ None	□ Clear	□ Clear/Blue
□ Mostly sunny	□ 20-30	✓ Slight breeze (1-5 mph)	□ Sulfide (rotten egg)	✓ Slightly turbid	□ Grayish
✓ Mostly cloudy	□ 30-40	□ Moderate winds (5-15 mph)	□ Fishy	□ Highly cloudy	□ Brownish
□ Overcast	□ 40-50	□ Strong gusts (15-25 mph)	□ Septic	□ Suspended solids/murky	□ Blackish
□ Humid	□ 50-60	□ Storm winds (> 25 mph)	□ Chlorine		□ Light yellow/tan
□ Foggy	□ 60-70	**River Water Level**	□ Petroleum		□ Dark tan
□ Drizzly	✓ 70-80	✓ Low (estimate minus .15 feet)	□ Musty (basement)		✓ Light green tint
□ Light rain	□ 80-90	□ Normal	□ Rotting vegetables		□ Green
□ Heavy rain	□ 90-100	□ High (estimate plus ___ feet)	□ Other ______		□ Reddish
□ Sleet	□ >100				□ Other ______
□ Snow					

Phytoplankton Presence (check all that apply): □ None □ Unobservable □ Sparse (0-25%) ✓ Moderate (25-75%) □ Dense (75-100%) ✓ Suspended □ Floating

Phytoplankton Description (general type, extent, color, condition, and location): Very small particles, greenish

Density of Aquatic Plants (check all that apply): □ None □ Unobservable (note why in description) ✓ Sparse (0-25%) □ Moderate (25-75%) □ Dense (75-100%) ✓ Emergent ✓ Floating ✓ Submerged

Aquatic Plant Description (list plants in general vicinity of station; note genus and species if known and location [streambed or near bank]): A few cattails, duckweed, pondweed — but mostly clear.

Presence of Periphyton (check all that apply): ✓ None □ Unobservable (note why in description) □ Sparse (0-25%) □ Moderate (25-75%) □ Dense (75-100%)

□ Attached on rocks or bottom	□ Attached on plants
□ Moss	□ Filamentous
□ Filamentous	□ Slimes
□ Thin film	□ Thin film
□ Floc	□ Floc

Periphyton Description (extent, color, condition, etc.): —

Sampling Location Information (for the visible stream reach, check multiple boxes if applicable, and DETERMINE LEFT/RIGHT BANK BY LOOKING *DOWNSTREAM*)

Scum(s) ✓yes □ no (include oil sheens, pollen/dust blankets and similar floating layers that reduce aesthetics)
Description of Scum(s) slight oil sheen in spots

Observed Use(s) (include indications of use even if use not observed) □ none □ swimming □ boating □ water intake ✓fishing □ other
Description of Observed Use(s) (include numbers or Indicators of Use(s)) junk fishing line observed / tangled banks

Objectionable Deposits □ none □ floating □ sunken ✓garbage/trash □ nuisance aquatic plants □ flocculent mass (rust colored or other) □ other
Description of Objectionable Deposits (type, extent and area affected...) a little trash on banks

Shoreline Erosion ✓yes □ no (describe any shoreline erosion observed, note location: look for existing and potential slope failures, landslides.)
Description of Erosion minor path erosion

Wildlife Sightings □ none ✓fish □ mammals ✓birds □ reptiles (snakes, turtles) ✓waterfowl □ amphibians (frogs, salamanders) □ other
Description of Wildlife Sightings (include numbers) or **Indications** (e.g. nests, beaver marks) small fish observed (?) Some song birds, mallards

Potential Pollution Sources □ none □ waste outfall pipes ✓garbage/trash dumping □ land clearing ✓green lawns □ shoreline residences □ other
Description of Potential Pollution Sources lawn runoff probable

For office use only Field Sheet Login # Unique ID # Revision Date 3/2003

Example of completed 2003 Rivers Field Sheet (side one).

SAMPLE DATA

Bottle Sample(s) collected? ☒ yes ☐ no

Local Time (24 hr.) 9:55 am ✓ pm ___

Samples taken from (check all that apply)

☐ from shore ☒ wade in ☐ boat ☐ other (explain)

☐ off bridge?: ☒ upstream side ☐ downstream side

☒ left bank ☐ right bank ☐ center stream

(looking *DOWNSTREAM* to determine left/right bank)

Van Dorn Serial #, if used: —

Notes: No Field blank taken for TSS.

OWMID #	Collection Method: Wade in	Bridge drop	Other**	Matrix: Effluent	Sediment (Z)	Water	Analyte/Bottle Group: Chemistry (C)	Nutrients* (N)	Solids ** (S)	Bacteria (B)	BOD/COD (D)	TOX ** (T)	Algae (I) (inc. Chl a)	Metals (M)	Apparent Color (R)	Other**	Sample Type: Grab: Manual Grab	Basket	Vandorn/Kemmerer	Composite: Width/Depth Integrated	Flow Composite	Time Composite	Other**	QA/QC: Field Blank	Duplicate***	Other**	Total # of bottles
51-0512	X					X	X	X	X	X							X								X		4
51-0513	X					X	X	X	X	X							X								X		4
51-0514			X			X	X	X		X														X			4

* preservatives used (for water matrix nutrients) (check one) ☒ 1:1 H_2SO_4 ☐ 1:1 HCl ☐ HNO_3 (metals)

** describe in notes

*** for duplicate samples: use different IDs for each sample, check 'Duplicate' column for each and leave blank lines before and after duplicate sets

Multi-Probe DATA Record last readings per Multi-probe SOP. For TDS/Salinity in table, circle one as applicable.

OWMID # 51-0515 **Notes:** Turbidity error noted in logger readout

Sonde # 24570

Surveyor # 24571

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (ntu)	TDS/Salinity (g/l)(ppt)	Redox (mV)
9:58	20.65	6.75	0.1	249	6.67	73.7	5.1	0.160	—

Cooler Temperature (post sampling at DWM Lab): 1.5 °C

R.C. **Survey Lead (initial)**

Example of completed 2003 Rivers Field Sheet (side two).

Massachusetts Department of Environmental Protection/Division of Watershed Management
Lakes and Ponds Field Sheet

Survey Lead (initial) MM | Station Sheet 1 of 2
General information (fill out prior to departure)

Project: Baseline Lakes
PALIS #: 81078
Lake: Lake Geneva
Town: Lancaster
Station ID#: Site A

General weather conditions last 3 days at: Ayer — http://ipsrd.nws.noaa.gov/er/box/climate.htm

date	SkyC	WxType	Tmpr	AvSp
9/5/03	1.4	R	0.21	9.2
9/4	2.0	R	0.07	8.1
9/3	0.8	–	0.00	4.4

Sampling Crew (full names (last name only is OK for year round DWM employees))
Lead: Mattson Others: Chase

Station Information (fill out at station)
Date 9/6/03 Local Time (24 hr.) 11:25 am ✓ pm ___ Photos taken? □ yes ☒ no
Description of Station Access (in detail including posted signs, restrictions on access, etc.) GPS: N/A
Boat launch off of Eustene Ave.

Station Description (describe precisely where samples are taken using shore markers, GPS, etc.; use consistent DWM station file descriptions)
2/3 across from boat launch — deep hole @ approx 150' from red house on shore

Lake level staff gage reading and source/type (if available) N/A

Current Weather (check all that apply)	Air Temperature (°F)	Wind Conditions	Odor (surface)	Water Clarity (check all that apply)	Water Color (color at ½ secchi depth as it appears on white secchi parts)
□ Clear	□ <10	□ Calm (0-1 mph)	□ None	□ Clear	□ Clear/Blue
□ Mostly sunny	□ 10-20	□ Slight breeze (1-5 mph)	□ Sulfide (rotten egg)	□ Slightly turbid	□ Grayish
□ Mostly cloudy	□ 20-30	☒ Moderate winds (5-15 mph)	☒ Fishy	☒ Highly turbid	□ Brownish
☒ Overcast	□ 30-40	□ Gusty (15-25 mph)	□ Septic	□ Suspended solids/murky	□ Blackish
□ Humid	□ 40-50	□ Strong winds (> 25 mph)	□ Chlorine		☒ Light yellow/tan
□ Foggy	□ 50-60		□ Petroleum		□ Dark tan
□ Drizzly	☒ 60-70	**Lake Water Level**	□ Musty (basement)		□ Light green tint
□ Light rain	□ 70-80	□ Low (estimate minus ___ feet)	□ Rotten vegetation		□ Green
□ Heavy rain	□ 80-90	☒ Normal	□ Other ______		□ Blue-Green
□ Sleet	□ 90-100	□ High (estimate plus ___ feet)			□ Reddish
□ Snow	□ >100				□ Other ______

Wind Direction (blowing from the …)	Wave Height	Presence of Algae (0-1 meter; check all that apply)	Density of Aquatic Plants (check all that apply)
□ Calm	□ Calm (0 in)	□ None	□ Unobservable (note why in description)
□ North	□ 0-2 in	□ Sparse (0-25%)	□ Sparse (0-25% cover)
□ Northeast	☒ 2-5 in	□ Moderate (25-50%)	☒ Moderate (25-50% cover)
☒ Northwest	□ 5-10 in	☒ Dense (50-75%)	□ Dense (50-75% cover)
□ South	□ 10-15 in	□ Very Dense (75-100%)	□ Very Dense (75-100% cover)
□ Southeast	□ 15-20 in	□ Floating scum (continuous surface bloom)	□ Emergent ☒ Attached epiphyton
□ Southwest	□ >20 in	**Algae Description** (describe shape: spherical, filamentous, flocculent…and note genus/species if known):	☒ Floating ☒ Submerged
□ East		algal strands dense with large clumps of more spherical algae mixed in	**Aquatic Plant Description** (list plants in general vicinity of site, note genus and species if known): Lots of lilies at South end. Milfoil and Egeria dominant
□ West			

Whole Lake Information (fill out for the lake as a whole, check multiple boxes if applicable and note locations of observations)

Scum(s) ☒ yes □ no (include oil sheens, pollen/dust blankets and similar floating layers that reduce aesthetics)
Description of Scum(s): Spherical algal clumps floating and dispersed in H_2O.

Observed Use(s) (include indications of use even if use not observed) □ none □ swimming ☒ boating □ water intake □ fishing □ other
Description of Observed Use(s) (include numbers) or Indicators of Use(s): 3-4 boats at far end (north end)

Objectionable Deposits □ none ☒ floating □ sunken □ garbage/trash ☒ nuisance aquatic plants □ flocculent mass (rust colored or other) □ other
Description of Objectionable Deposits (type, extent and area affected…) → very "visible" despite high turbidity.

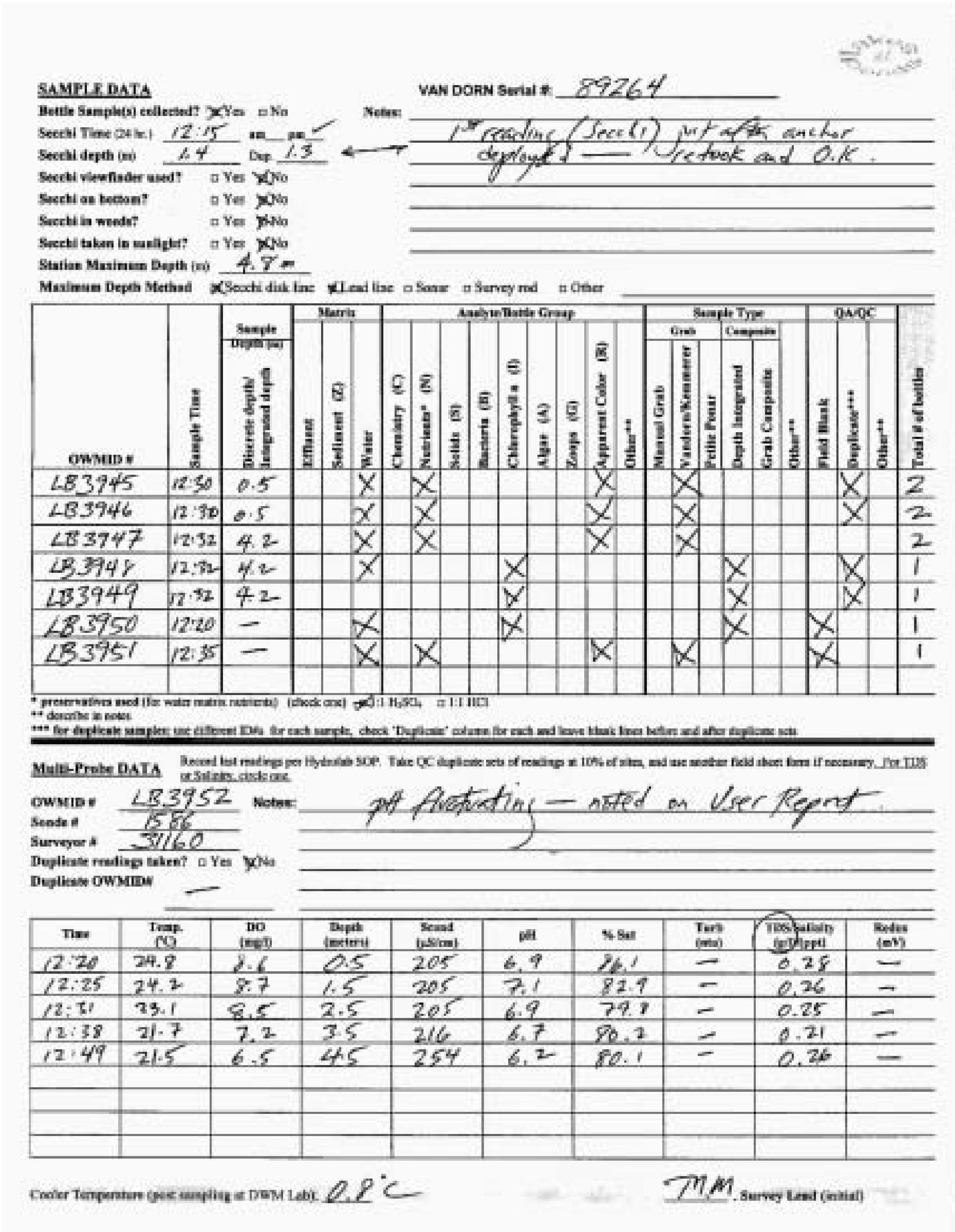
Shoreline Erosion □ yes ☒ no (describe any shoreline erosion observed, note location: look for existing and potential slope failures, landslides.)
Description of Erosion —

Wildlife Sightings □ none ☒ fish □ mammals □ birds □ reptiles (snakes, turtles) ☒ waterfowl □ amphibians (frogs, salamanders) □ other
Description of Wildlife Sightings (include numbers) and/or Indications (e.g. goose droppings, nests, etc.) bluegill; great blue heron (1); Canada geese

Potential Pollution Sources □ none □ waste outfall pipes □ garbage/trash dumping □ land clearing □ green lawns ☒ shoreline residences □ other
Description of Potential Pollution Sources: septic systems to lake (approx. 50 homes)

For office use only Field Sheet Login # Unique ID # Revision Date 2/2003

Example of completed 2003 Lakes Field Sheet (side one).



SAMPLE DATA VAN DORN Serial #: 89264

Bottle Sample(s) collected? ☒Yes ☐No

Secchi Time (24 hr.) 12:15 am __ pm ✓

Secchi depth (m) 1.4 Dup. 1.3

Secchi viewfinder used? ☐ Yes ☒No

Secchi on bottom? ☐ Yes ☒No

Secchi in weeds? ☐ Yes ☒No

Secchi taken in sunlight? ☐ Yes ☒No

Station Maximum Depth (m) 4.7 m

Maximum Depth Method ☒Secchi disk line ☒Lead line ☐ Sonar ☐ Survey rod ☐ Other

Notes: 1st reading (Secchi) just after anchor deployed — retook and O.K.

OWMID #	Sample Time	Sample Depth (m) Discrete depth/ Integrated depth	Matrix: Effluent	Sediment (Z)	Water	Analyte/Bottle Group: Chemistry (C)	Nutrients* (N)	Solids (S)	Bacteria (B)	Chlorophyll a (I)	Algae (A)	Zoops (G)	Apparent Color (R)	Other**	Sample Type: Grab: Manual Grab	Vandorn/Kemmerer	Petite Ponar	Composite: Depth Integrated	Grab Composite	Other**	QA/QC: Field Blank	Duplicate***	Other**	Total # of bottles
LB3945	12:30	0.5			X		X						X			X						X		2
LB3946	12:30	0.5			X		X						X			X						X		2
LB3947	12:32	4.2			X		X						X			X								2
LB3948	12:32	4.2			X					X								X				X		1
LB3949	12:32	4.2								X								X				X		1
LB3950	12:20	—			X					X								X			X			1
LB3951	12:35	—			X		X						X			X					X			1

* preservatives used (for water matrix nutrients) (check one) ☒1:1 H_2SO_4 ☐ 1:1 HCl

** describe in notes

*** for duplicate samples: use different IDs for each sample, check 'Duplicate' column for each and leave blank lines before and after duplicate sets.

Multi-Probe DATA Record last readings per Hydrolab SOP. Take QC duplicate sets of readings at 10% of sites, and use another field sheet form if necessary. For TDS or Salinity, circle one.

OWMID # LB3952 Notes: pH fluctuating — noted on User Report

Sonde # 1586

Surveyor # 31160

Duplicate readings taken? ☐ Yes ☒No

Duplicate OWMID# —

Time	Temp. (°C)	DO (mg/l)	Depth (meters)	Scond (µS/cm)	pH	% Sat	Turb (ntu)	TDS/Salinity (g/l)(ppt)	Redox (mV)
12:20	24.8	8.6	0.5	205	6.9	86.1	—	0.28	—
12:25	24.2	8.7	1.5	205	7.1	82.9	—	0.26	—
12:31	23.1	8.5	2.5	205	6.9	79.8	—	0.25	—
12:38	21.7	7.2	3.5	216	6.7	80.2	—	0.21	—
12:49	21.5	6.5	4.5	254	6.2	80.1	—	0.26	—

Cooler Temperature (post sampling at DWM Lab): 0.8°C

MM Survey Lead (initial)

Example of completed 2003 Lakes Field Sheet (side two).

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection
Senator William X. Wall Experiment Station

Sample Tracking/ Chain-of-Custody Record

Cooler Temperature at Receipt ______ °C

WES Sample Log-In # ________________________

Project Description

Name: ______________

Site Name: ______________

RTN: ______________

Case #: ______________

Coordinator ______________

Region–Bureau-Division

NERO ___ SERO ___
CERO ___ WERO ___

Bureau: ______________

Division: ______________

Phone: ______________

Fax: ______________

Analytical Laboratory
(for samples sent to a laboratory other than WES)

Name: ______________

Address: ______________

Contact: ______________

MA Cert# ______________

Phone# ______________

Field Locator (within Site)	Client ID (Field #)	Lab # (Log-In # above plus # below)	Collection		Receipt		Sample			Collector	Chlorine Residual (yes/no)	Analysis Requested
			Date	Time	Date	Time	G/C*	Matrix**	Preservative			

Remarks:

***G/C = Grab/Composite**

Chain of Custody: (*signatures required only for COC*)

Relinquished by:					Received by:				
Printed name	***Signature***	***Org.***	***Date***	***Time***	***Printed name***	***Signature***	***Org.***	***Date***	***Time***

** MATRIX CODES				
AC = Air Canister	FBT = Fish/Biological Tissue	LL = Landfill Leachate	SOIL = Soil	WO = Waste Oil
ACT = Air Cartridge Tube	GW = Ground Water	LW = Liquid Waste	SRW = Surface Water	WW = POTW Wastewater
AF = Air Filter	GRYW = Greywater	ME = Marine/Estuarine Water	STW = Stormwater/CSO	WWS = Wastewater Sludge
DW = Drinking Water	IWW = Industrial Wastewater	SED =-Sediment	SW = Solid Waste	

Rev. # 1.0, January 2001

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection
Senator William X. Wall Experiment Station

Sample Tracking/ Chain-of-Custody Record

Cooler Temperature at Receipt 4 °C

WES Sample Log-In # ______

Project Description
Name: Baseline Lakes
Site Name: Fake Lake
RTN:
Case #:
Coordinator MATTSON

Region–Bureau-Division
NERO ___ SERO ___
CERO ___ WERO ___
Bureau: BRP
Division: DWM
Phone: 508 767 2868
Fax: 508 791 4131

Analytical Laboratory
(for samples sent to a laboratory other than WES)
Name:
Address:
Contact:
MA Cert#
Phone#

Field Locator (within Site)	Client ID (Field #)	Lab # (Log-In # above plus # below)	Collection		Receipt		Sample			Collector	Chlorine Residual (yes/no)	Analysis Requested
			Date	Time	Date	Time	G/C*	Matrix**	Preservative			
541 Deephole 0.5	LB1201 C		7/21/01	1435			G	SRW	4°C	Smith		Low Alkalinity
541 "	LB1201 N								H2SO4			TP Low
541 Deephole 4.5	LB1202 C								4°C			Low Alkalinity
"	LB1202 N								H2SO4			Low TP
641 NW Inlet	LB1205 N								"			Low TP
722 Composite ABC	LB1212 S			1510			C	SED	4°C	MATTSON		TP TFe % solid % organic

Remarks:

*G/C = Grab/Composite

Chain of Custody: (*signatures required only for COC*)

Relinquished by:					Received by:				
Printed name	Signature	Org.	Date	Time	Printed name	Signature	Org.	Date	Time
MARK MATTSON	Mark Mattson	DWM	7/21/01	1710	Summer Ian	Sum Ia	DWM intern	7/21/01	1710
Summer Ian	Sum Ia	DWM intern	7/22/01	1100	Mr Laboratory	[illegible]	WES	7/22/01	1100

** MATRIX CODES				
AC = Air Canister	FBT = Fish/Biological Tissue	LL = Landfill Leachate	SOIL = Soil	WO = Waste Oil
ACT = Air Cartridge Tube	GW = Ground Water	LW = Liquid Waste	SRW = Surface Water	WW = POTW Wastewater
AF = Air Filter	GRYW = Greywater	ME = Marine/Estuarine Water	STW = Stormwater/CSO	WWS = Wastewater Sludge
DW = Drinking Water	IWW = Industrial Wastewater	SED =-Sediment	SW = Solid Waste	

Rev. # 1.0, January 2001
W:\office\coc-form\FORMCOC.DOC

Severn Trent Laboratories, Inc.
Chain of Custody Form

SEVERN TRENT **STL** 01022

•53 Southampton Road
Westfield, MA 01085
(P) 413-572-4000
(F) 413-572-3707
STL-WESTFIELD

•149 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871
STL-BILLERICA

Client: ______ Project #: ______ Job# ______ Quote# ______ PO# ______

Address: ______ Project Manager: ______

______ Work ID: ______

Phone: ______ Fax: ______ Contact: ______

Shaded areas for office use

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments
(Special Instructions)

Requested Turn Around Time
10 Business Day (Std) ______ | Rush TAT Requested:
15 Business Day ______ | 24 hrs ___ 72 hrs ___
Other ______ | 48 hrs ___ 5 Day ___

Regulatory Classification / Special Report Format
NPDES ______ Drinking Water ______ **DEP Form(s)** ______
RCRA ______ MCP GW1/S1 ______ **MWRA Smart Rpt** ______
Other ______ **MCP QA/QC Rpt** ______

Sample Type Codes
WW-Wastewater DW-Drinking water SW-Surfacewater
LW-Labwater GW-Groundwater A-Air
S-Solid / Soil SL-Sludge O-Oil Z-Other

Sample ID	Sample Type	Sampler's Initials	Date / Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	Preservative: NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >12	Na2S2O3	None / 4° C	Volatiles 524 / 624	Volatiles 8260 / 8021	Semivols 625	Semivols 8270	PCB / Pesticides	EPH / VPH	DRO / GRO	Metals 6010 / 200.7	General Chemistry	Bacteriological	Toxicity	Oil & Grease / TOC	Other

Sampled by (print): ______ Signature: ______

Relinquished by: ______ Date: ______ Time: ______ Received by: ______ Date: ______ Time: ______

Relinquished by: ______ Date: ______ Time: ______ Received by: ______ Date: ______ Time: ______

Method of shipment: ______ ***STL-Westfield***

Cooler ? Y / N Samples Iced? Y / N
Temp @ receipt ______ °C
Preservation/pH checked
By: ______ Date: ______

Page ____ of ____

White = Lab file Yellow = Report copy Pink = Customer copy

STL8245 (6/01)

Severn Trent Laboratories, Inc.
Chain of Custody Form

SEVERN TRENT STL

01022

•53 Southampton Road
Westfield, MA 01085
(P) 413-572-4000
(F) 413-572-3707
STL-WESTFIELD

•149 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871
STL-BILLERICA

Job#: | Quote#: | PO#:

Client: MADEP - DWM
Address: 627 Main St. 2nd Floor
Worcester, MA. 01608
Phone: 508-767-2859 Fax: 508-791-4131

Project #: CN2003-1 (TBD)
Project Manager: R. CHASE
Work ID: (TBD)
Contact: R. Chase 767-2859

Shaded areas for office use.

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for trace/solid waste
Use comments section to further define.

Comments (Special Instructions)

BACT. = Fecal E. coli

CHEM = TSS Turbidity

Requested Turn Around Time
10 Business Day (Std) ✓
15 Business Day ____
Other ____
Rush TAT Requested
24 hrs ____ 72 hrs ____
48 hrs ____ 5 Day ____

Regulatory Classification / Special Report Format
NPDES ____ Drinking Water ____ DEP Form(s) ____
RCRA ____ MCP GW1/S1 ____ MWRA Smart Rpt ____
Other ____ MCP QA/QC Rpt ____

Sample Type Codes
WW-Wastewater DW-Drinking water SW-Surfacewater
LW-Labwater GW-Groundwater
S-Solid / Soil SL-Sludge O-Oil Z-Other

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >12	Na2S2O3	None / 4° C	Volatiles 524 / 624	Volatiles 8260 / 8021	Semivols 625	Semivols 8270	PCB / Pesticides	EPH / VPH	DRO / GRO	Metals 6010 / 200.7	General Chemistry	Bacteriological	Toxicity	Oil & Grease / TOC	Other
34-0482	SW	P.M.	5/12/03 8:05	X		1	P						X											X			
34-0487	↓	↓	5/12/03 8:45	X		1	P						X											X			
34-0492	↓	↓	5/12/03 9:30	X		1	P						X											X			
34-0497	↓	↓	5/12/03 10:20	X		1	P						X											X			
34-0502	↓	↓	5/12/03 11:35	X		1	P						X											X			
34-0483	↓	↓	5/12/03 8:10	X		1	P							X									X				
34-0488	↓	↓	5/12/03 8:50	X		1	P							X									X				
34-0493	↓	↓	5/12/03 9:35	X		1	P							X									X				
34-0498	↓	↓	5/12/03 10:25	X		1	P							X									X				
34-0503	↓	↓	5/12/03 11:42	X		1	P							X									X				

Sampled by (print): Pete Mitchell 5/12/03 Signature: Pete Mitchell

Relinquished by: Pete Mitchell Date: 5/12/03 Time: 14:35 Received by: Bob Brown Bob Brown Date: 5/12/03 Time: 14:35

Relinquished by: Date: Time: Received by: Date: Time:

Method of shipment: Hand-delivered

STL-Westfield

Cooler? Y / N Samples Iced? Y / N
Temp @ receipt: ____ °C
Preservation/pH checked
By: Date:

Page 1 of 1

White = Lab file Yellow = Report copy Pink = Customer copy

STL 8265 (REV 7/03)

Investigator(s) ______________________ Reference Site ______________________

River Basin ______________________ Stream Name ______________________ Saris # ______________________

Describe Site Location: ______________________

Protocols for Wadable Riffle/Run Prevalent Streams: those in moderate to high-gradient landscapes that sustain water velocities of approximately 30 cm/sec or greater. Natural streams have substrates primarily composed of coarse sediment particles (i.e., gravel or larger) or frequent coarse particulate aggregations along stream reaches.

Habitat Parameter	**Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Instream Cover **(Fish)**	A mix of snags, submerged logs, undercut banks, rubble, or other stable habitat in greater than 50% of the sample area	30-50% of area with a mix of stable habitat; adequate habitat for maintenance of populations	10-30% of area with a mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% of area with a mix of stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Epifaunal Substrate **(in sampled area only)**	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble. (Boulders prevalent in headwater streams).	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or bedrock prevalent; some cobble present.	Riffles or runs virtually nonexistent; bedrock prevalent; cobble lacking.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Embeddedness **(riffles/runs)**	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 y) may be present, but recent channelization is not present.	New embankments present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat Parameter	Category: Optimal	Category: Suboptimal	Category: Marginal	Category: Poor
6. Velocity-Depth Combinations 1. slow deep 2. fast deep 3. slow shallow 4. fast shallow **(frequency of riffles or bends)**	**All 4 velocity/depth patterns present**. Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstructions is important.	**Only 3 of 4 velocity/depth patterns present** (i.e., slow [<0.3 m/s]-deep [>0.5 m]; slow-shallow; fast-deep; fast-shallow). Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	**Only 2 velocity/depth patterns present**; usually lacking deep areas. Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	**Dominated by one velocity/depth pattern**. Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces covered by naturally occurring vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; **almost all plants allowed to grow naturally**.	70-90% of the streambank surfaces covered by naturally occuring vegetation, but one class of plants is not well-represented; **disruption evident but not affecting full plant growth** potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; **disruption obvious**; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; **disruption of streambank vegetation is very high**; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ______ **(LB)**	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ______ **(RB)**	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Stability (score each bank)	Banks stable; evidence of erosion or **bank failure absent or minimal**; little potential for future problems. <5% of bank affected.	Moderately stable; **infrequent, small areas of erosion mostly healed over**. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; **high erosion potential during floods**.	Unstable; many eroded areas; **"raw" areas frequent along straight sections and bends**; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ______ **(LB)**	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ______ **(RB)**	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of **riparian zone >18 meters**; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of **riparian zone 12-18 meters**; human activities have impacted zone only minimally.	Width of **riparian zone 6-12 meters**; human activities have impacted zone a great deal.	Width of **riparian zone <6 meters**: little or no riparian vegetation due to human activities.
SCORE ______ **(LB)**	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ______ **(RB)**	Right Bank 10 9	8 7 6	5 4 3	2 1 0

TOTAL SCORE ______

comments:

APPENDIX J

WES LAB DATA REPORT FORMAT (*EXAMPLE*)

(see CD version for example STL-Westfield Lab Report)

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL ANALYSIS
WILLIAM X. WALL EXPERIMENT STATION
EPA#: MA00019

Final Analysis Report for Log Number: L2000428

Prepared For: CERO BRP DIV OF WATERSHED MANAGEMENT **Receive Date:** 17-OCT-00
Project Name: **Collector:** BFF/LK

Sample #: L2000428-1 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** SO05
Field #: 33-0232C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	38	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	0.28	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	48	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Sample #: L2000428-2 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** SO01
Field #: 33-0233C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	43	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	0.80	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	49	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Sample #: L2000428-3 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** DR10
Field #: 33-0234C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	17	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	0.69	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	23	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Sample #: L2000428-4 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** GR02
Field #: 33-0235C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	44	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	1.2	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	53	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Sample #: L2000428-5 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** GR03
Field #: 33-0236C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	45	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	1.1	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	53	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Sample #: L2000428-6 **Collect Date:** 10/17/00 **Site:** DEERFIELD RIVER **Locator:** GR03A
Field #: 33-0237C **Matrix Class:** LIQUID

Analyte/Compound	Result	Units	MDL	RDL	Method	Analysis Date
Alkalinity	46	mg/L	2	2	SM2320B	18-OCT-00
Turbidity	1.1	NTU	0.10	0.10	EPA 180.1	18-OCT-00
Hardness	53	mg/L	0.66	0.66	SM 2340B	19-OCT-00

Approved***: Date: NOV-24-00
***QA Level 1 & 2 Completed - documentation available upon request.

APPENDIX K

DWM Corrective Action Initiation Form (Example)

CORRECTIVE ACTION INITIATION FORM
(front page**)**
(To be completed by Originator)

Initiator:__*Mark Mattson*__ Date*: 1/24/2000*_________ CAI#:_____*1.0*________

Description of the problem: In reviewing data from the Baseline Lakes survey of 1999 I noticed an apparently low value for Total Phosphorus from Ganawatte Farm Pond during the second set of samples. I checked the WES data sheet and noticed that the sample LB0182 was footnoted with the remark "Sample Filtered after digestion to remove iron". Checking further I found 4 other samples so indicated, all analyzed on 8/17/99, but none of the other 100 or so samples had this note, including other samples from the same pond taken before and after the sample in question. I checked Standard methods 4500-P E which lists several interferences, but iron is not one of them. Since the sample was filtered, I assume some particulate precipitate had formed. I can not tell from WES methods number which digestion was used. If perchloric or the sulfuric+nitric disgestion was used filtering is allowed. However, if persulfate digestion was used filtering is not allowed as the method states after digestion neutralize and make up to 100ml with distilled water. In some samples a precipitate may form at this stage but do not filter.

I would like some clarification as to the digestion used and the reason for filtering and, if needed, an additional test such as a comparison between digestion methods to determine if the iron interference persists in all methods.

Pertinent Information/data*: LB0182N is WES number L990347-5*

(To be completed by Monitoring Coordinator/QA/QC Officer)

Operations/data affected: *Total Phosphate: LB0182N is WES number L990347-5*

Corrective Action Plan: *Contact laboratory and review Total Phosphate digestion methods used at WES. See if the filtering of the TP samples was an acceptable technique. Provide an opportunity for the analysts to discuss a solution.*

Estimated Corrective Action Completion Date*: 02/04/00*

Approval of the Corrective Action Plan:

Initiator (date): _*Mark Mattson_ 1/24/00*

Monitoring Coordinator (date): ____________________

QA/QC Analyst (date): ____________________

CORRECTIVE ACTION INITIATION FORM
(back page)

Results of the Corrective Action:

1/26/00 - Received e-mail from Ken Hulme and Jim Sullivan at WES (see hardcopy). Jim Sullivan and Mark Mattson discussed details on the phone and agreed to investigate further.

Several emails were sent back and forth on this issue with further consultation with other laboratories which generally confirmed the ppt is iron (rust), but that it probably should not be filtered out. The following is Jim Sullivan's email of 2/9/2000 which I find to be a satisfactory resolution for now. -Mark Mattson 2/15/2000

Original text
From: James Sullivan@BSPT DEA@DEP WES, on 02/09/2000 12:58 PM:

Mark

If we get any more samples like these(anaerobic and highly colored), I thought I would try not filtered at all, filtered after digestion while still acidic, and the method of standard addition. We could then compare the results.

Jim

This resolution effects future work, however, it does not correct the data already analyzed. I recommend that the samples ***LB0005N, LB0181N, LB0182N,***
LB0185N and LB0155N, *be censored. -Mark Mattson*

Data Corrected:

Date Corrected: 2/15/00

Acceptance of the Corrective Action:

Monitoring Coordinator (date): ____________________

QA/QC Analyst (date): ____________________

APPENDIX L

Potential Non-Year-2 Fish Toxics Monitoring Stations

Note: The 2003 fish toxics monitoring level of effort may be significantly reduced, based on resource limitations and practical concerns (see Executive Summary)

The following **non-Year 2 waterbodies** may be sampled in 2003 for fish tissue contaminants (selected metals, PCBs and organochlorine pesticides):

National Study of Chemical Residues in Fish Tissue:
Rockwell Pond, Leominster

Public Requests:
Whitman's Pond, Weymouth
Buckmaster Pond, Westwood
Metacomet Lake, Belchertown
Wenham Lake, Beverly/Salem

MA BRP, Office of Research and Standards
TBD (potentially three lakes)